PERFORMANCE INNOVATION LABORATORIES

DROP TESTING REPORT FOR NASA TOL0702030

Report by: Billy Lee **Title:** Process/Test Engineering Specialist **Signature:** _____ **Date: November 2nd, 2009**	**Approved by: Jason Bragg** **Title:** Operations Engineering Advisor **Signature:** _____ **Date: November 2nd, 2009**

CLIENT INFORMATION

Client Name: Kurt Kessel
Company Name: TEERM NASA Principal Center (ITB, Inc.)
Address: Kennedy Space Center, FL 32899
Email: (321) 867-8480
Telephone: kurt.r.kessel@nasa.gov

ISO9001 Registered #001917

CELESTICA INC.
Performance Innovation Laboratories
844 Don Mills Road
Toronto, Ontario
M3C 1V7
www.celestica.com/engineering

Contact: Marianne Romansky
Telephone: 416-448-6284

General Inquiries: 416-448-5800

Revision History			
Revision	**Created by**	**Date**	**Short Description**
1	**Billy Lee**	**Nov. 2, 2009**	**Initial Version**

PROJECT SUMMARY

A board-level drop shock test was performed on NASA DOD LFE Lead-free and Mixed (leaded/lead-free) circuit board assemblies. The testing followed the statement of work titled "LFE Drop Test SOW CELESTICA.DOC" supplied by ITB, Inc. on September 4th, 2007. Twenty assemblies in all were drop tested. Each board was monitored for shock response and selective component net resistance. In addition, five cards were monitored for strain at 4 locations each. The assemblies were fixtured to a drop table and subjected to ten shocks at 500G. The input shocks were consistent, varying on average less than 2% under and 5% over 500G from drop to drop and batch to batch. The duration for each drop was very consistent as well, with a minimum of 1.88ms and a maximum of 2.02ms for the entire project.

The strain level of each strain gauge was consistent throughout all drops. For all five cards the average maximum and minimum principal strain levels were the same within test error. The average maximum principal strain at SG1, SG2, SG3 and SG4 were 2900ue, 3500ue, 4600ue and 4700ue respectively. The average minimum principal strain at SG1, SG2, SG3 and SG4 were -1800ue, -2000ue, -2000ue and -2500ue respectively. Since SG3 & SG4 were attached close to center of the test board, the strain readings were higher due to greater deflection of the board. As expected, strain readings at SG1 & SG2 were lower than SG3 & SG4 since they were attached away from the center of the board.

As expected, the only component type to show a significant number of electrical failures during this test were the PBGAs. The PBGA-225 electrical failures mostly occurred at or near the corner joints. Twenty-eight out of the 176 PBGAs survived all 10 drops. The surviving parts were located near the outer edge of the board where the strain was found to be minimal. The earlier Crane test had 25/90 PBGAs survive 10 drops; however none of the Crane PBGAs were reworked. On average, most reworked parts failed after a fewer number of drops than compared to non-reworked BGAs. Surprisingly, there was no significant difference in the number of drops until failure between BGAs reworked 1x vs. 2x, vs. 3x, perhaps physical failure analysis will explain this phenomenon. As expected, SnPb and SAC305 BGAs on ImmAg boards had similar failure rates, possibly due to the predominance of pad cratering (FA required to verify). PBGAs reflowed on ENIG boards typically failed after fewer drops than those on ImmAg boards; future physical failure analysis may reveal brittle interfacial fractures at the Ni board side.

There were no electrical fails for the CABGA-100, QFN-20 or TSOP-50 parts during the 10 drops. Future physical failure analysis however may reveal hidden mechanical damage which could be a reliability concern. Only three of the 60 CLCC-20 parts showed electrical fails (all failed during the 4th drop). It would be interesting to know the physical failure mechanism of these outliers. One of the QFP-144 parts showed an electrical fail during drop 3, note however that this part was marked as a "touch-up" by the assembly team.

Although there were duplicates of each component type on the test vehicle, every component experienced a unique strain/strain rate condition due to its particular location on the board. As a result each sample depicts a unique data point and these cannot be easily lumped together. Due to the limited number of samples, the absence of physical failure analysis (at this time) and the large number of electrically survivors, excluding the BGAs, it is not possible to draw any firm conclusions as to the significance of the electrical failure data.

It is likely that a great deal of the electrically-functional parts on these drop tested boards have hidden mechanical failures. Any future physical failure analysis should include dye and pry mapping of the majority of the components from a sample of the boards. The results of the dye and pry analysis could then be used to determine which of the remaining parts/boards should be targeted for cross-sectional analysis and possibly scanning electron microscopy to characterize the damage.

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1. EXCERPT FROM PROJECT DOCUMENT (NASA-DoD LFEP_JTP_Sept-2009.doc)

1.1 Drop Testing

1.1.1 Test Description

This test determines the resistance of board level interconnects to board strain induced by dynamic bending as a result of drop testing. Boards tested using this method typically fail either as interfacial fractures in the solder joint (most common with ENIG) or as pad cratering in the component substrate and/or board laminate (see Figure 1). These failure modes commonly occur during manufacturing, electrical testing (especially in-circuit test), card handling and field installation. The root cause of these types of failures are typically a combination of excessive applied strain due to process issues and/or or weak interconnects due to process issues and/or the quality of incoming components and/or boards.

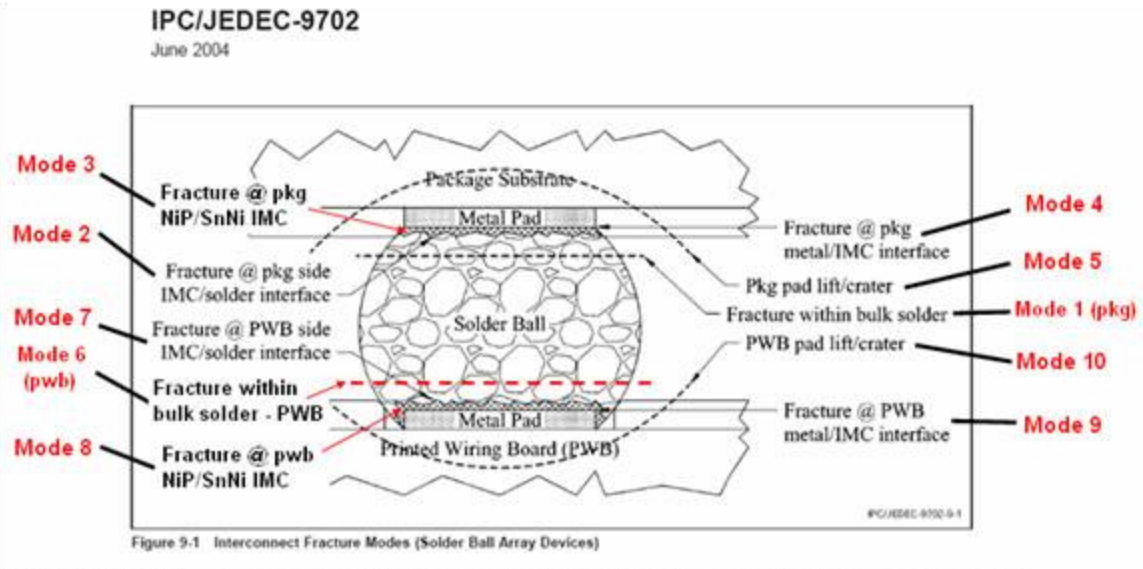


Figure 1: Interconnect Fracture Modes (Solder Ball Array Device) IPC 9702.

This board-level drop test is based on the JEDEC Standard JESD22-B110A known as Subassembly Mechanical Shock as well as insight gained by Celestica after performing numerous drop tests.

The drop test process can identify design, process, and raw material related problems in a much shorter time frame than other development tests. In this project, the drop test will determine the operation and strain endurance limits of the solder alloys and interconnects by subjecting the test vehicles to accelerated environments. The limits identified in drop testing will be used to compare performance differences in the lead-free test alloys and mixed solder joints vs. the baseline standard SnPb (63/37) alloy. The primary accelerated environments are strain and strain rate.

1.1.2 Drop Test Rationale

The Drop Testing will provide a method to identify comparative potential quality and reliability differences in the pure and mixed test alloys vs. the SnPb baseline in a short period of time. Unique to this test will be comparing the interconnect robustness of as-assembled to reworked boards.

1.1.3 Drop Test Resistance Monitoring

24 components will be monitored during the NASA-DoD LFE Project Drop Testing procedure.

Table 1: Components to be Monitored During Drop Testing

Ref-Des	Component		Ref-Des	Component		Ref-Des	Component
U02	BGA-225		U18	BGA-225		U42	CSP-100
U03	TQFP-144		U19	CSP-100		U43	BGA-225
U04	BGA-225		U20	TQFP-144		U44	BGA-225
U05	BGA-225		U21	BGA-225		U50	CSP-100
U06	BGA-225		U24	TSOP-50		U52	CLCC-20
U13	CLCC-20		U25	TSOP-50		U56	BGA-225
U14	CLCC-20		U32	CSP-100		U57	TQFP-144
U15	QFN		U33	CSP-100		U58	TQFP-144

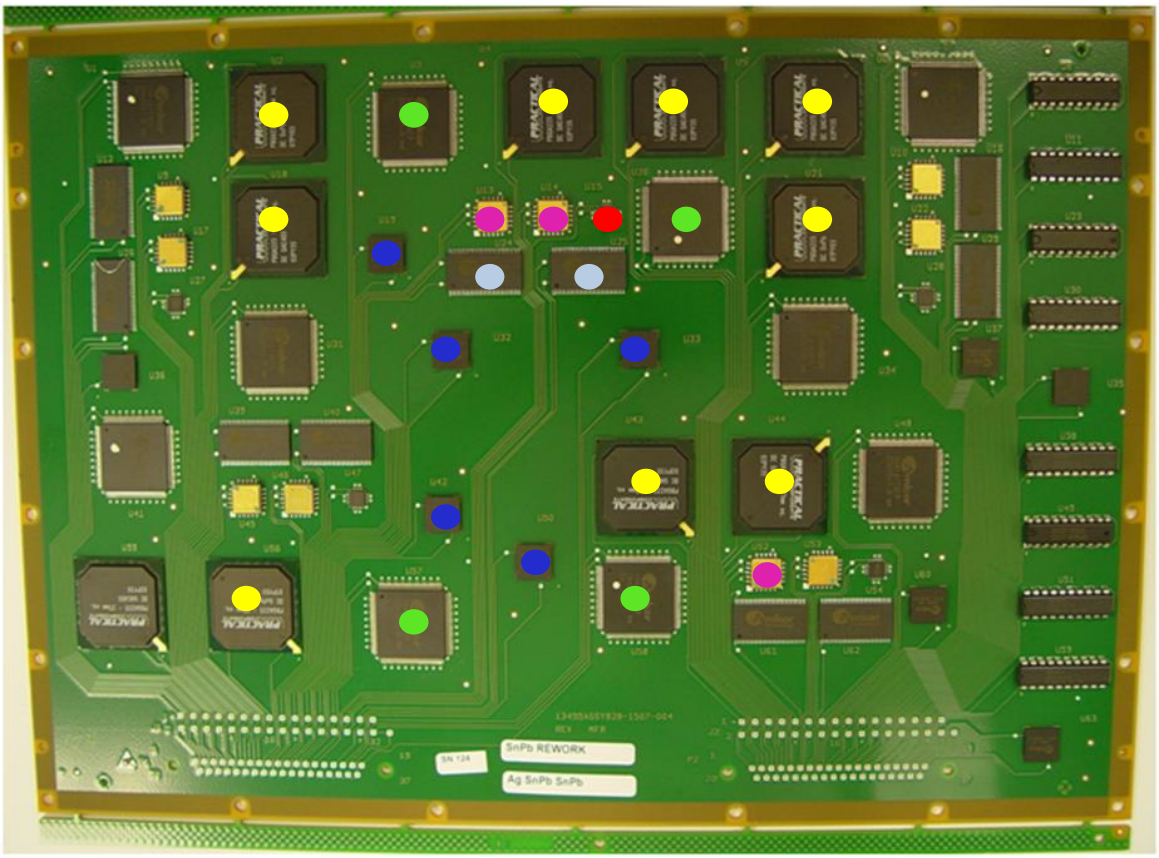
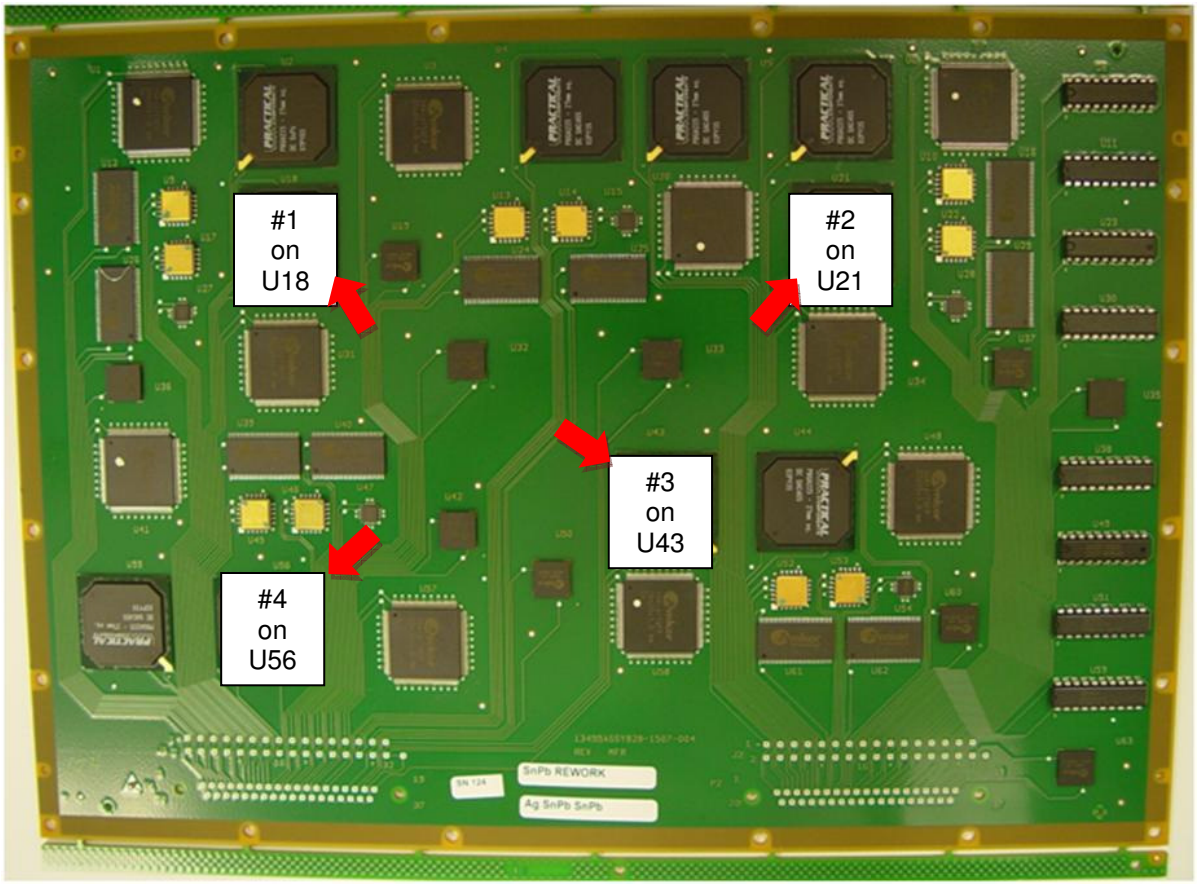


Figure 2: Components Being Electrically Monitored During Drop Testing

Strain Gage

- 4 strain gages on one setup card
- 4 strain gages on one card from each of the 5 cells
- The strain data will only be collected and analyzed on the 1st, 5th and 10th drops



Note: strain gages have been placed at the inner most corners of the largest BGAs these area are expected to see the greatest strains. If set-up testing shows something different, the strain gages can be relocated.

Figure 3: Location of the four triaxial strain gages

Table 2 Drop Test Methodology

Parameters	▪ Shock testing will be conducted in the -Z direction ▪ 500Gpk input, 2ms pulse duration ▪ Test vehicles will be dropped until all monitored components fail or 10 drops have been completed			
Number of Test Vehicles Required				
As Manufactured		Reworked		
Mfg. SnPb	Mfg. LF	Rwk. SnPb	Rwk. SnPb ENIG	Rwk. LF
5	5	5	1	5
Trials per specimen		A maximum of 10 drops		

2. PRODUCT INFORMATION

Products Under Test	Lead-free and Mixed (lead/lead-free) Circuit Board Assemblies
Quantity Provided	20
Serial Numbers	Batch A: **184, 185, 186, 187, 188** Batch B (Imm. Ag): **144,145, 146, 147, 148** Batch B (ENIG): **159** Batch D: **25, 26, 27, 28, 29** Batch F (Imm. Ag): **58, 59, 77, 92**

3. TEST SPECIFICATIONS

Name	Reference #	Level/Control
LFE DropTest SOW CELESTICA	N/A	August 31, 2007
JEDEC Standard on Subassembly Mechanical Shock	JESD22-B110A	November 2004

4. INSTRUMENTATION

Description	Serial Number	Calibration Due Date
Lansmont Model 65/81 Shock Table	ST-681-0062	N/A
Lansmont TP3 Data Collection System	N/A	N/A
Accelerometer: Endevco 2226C	GG11	Aug 20, 2009
Accelerometer: Endevco 2226C	KC88	Jul 29, 2010
Accelerometer: PCB P357C10	13852	Mar 22, 2010
Accelerometer: PCB P357C10	13850	Aug 11, 2010
Accelerometer: Endevco 2222C	BP17	Feb 10, 2010
Accelerometer: Endevco 2222C	27654	Sep 18, 2009
Vishay Measurements 6000 Model 6100	N/A	N/A
Anatech 64 STD (upgraded to 192)	950307-1	Jan 28, 2010

5. ANALYSTS

Name	Employee #	Title
Billy Lee	07009698	Process/Test Engineering Specialist
Russell Brush	07044151	Operations Engineering Specialist
Subramaniam Suthakaran	07002151	Engineering Technical Support 3

6. DROP SHOCK TEST

As requested by NASA, the following shock testing was performed on the test units:

- Shock parameters: 500 G, 2.0 ms duration
- Number of drops per card: 10
- 20 cards in total / 3 cards tested simultaneously per drop for the first 6 sets / 2 cards tested for set 7. See below and Appendix A for test setup photos.
- Each card was monitored with an accelerometer for shock response.
- Each card was monitored in-situ for resistance changes (see section 7 for components and results).
- Cards 25, 58, 148, 159, 187 were also monitored for board strain.

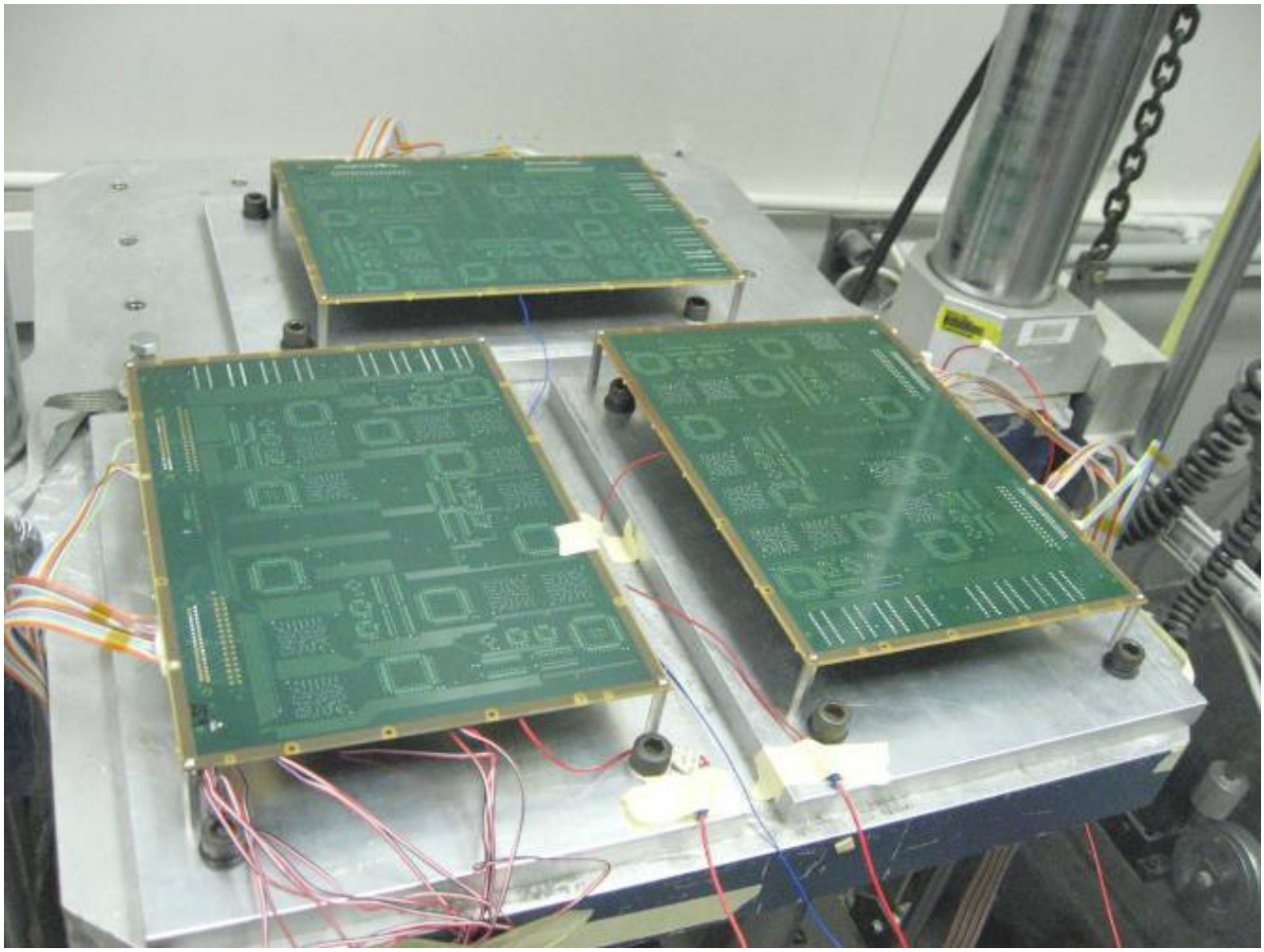


Figure 4: Test Setup.

6.1 Summary of Drop Testing – Shock Forces

The input shocks from the drop table were consistent for all 7 sets, varying on average less than 2% under and 5% over 500G. The duration for each drop was also very consistent with a minimum of 1.88ms and a maximum of 2.02ms. See the following tables for details.

6.1.1 Set 1: cards 144, 159, 185

	Table		Card 144		Card 185		Card 159 (strain gauged)	
Drop	**G's**	**ms**	**G's**	**ms**	**G's**	**ms**	**G's**	**ms**
1	495	1.98	n/a	n/a	n/a	n/a	n/a	n/a
2	494	1.98	2348	0.50	5144	0.48	215	9.48
3	497	1.98	2324	0.50	5958	0.46	1936	1.98
4	491	2.00	2152	0.48	5836	0.46	2033	1.38
5	500	1.96	34	0.54	5853	0.48	1982	1.42
6	490	1.98	31	0.58	5778	0.48	1966	1.42
7	492	1.98	1593	0.52	1410	0.70	1378	0.66
8	492	1.98	1516	0.52	1364	0.68	1324	0.64
9	501	1.96	1385	0.54	1346	0.66	1273	0.58
10	492	1.98	1469	0.52	1357	0.64	2364	0.32

The following notes were taken during the drop testing. See Appendix B for response graphs.

Drop	Card	Issue	Notes / Action Taken
1	all	No G values recorded	Channels for the three cards not activated.
2	159	Low G value recorded	Accelerometer broke off – reattached.
5	144	Low G value recorded	Checked accelerometer and all cable connections.
6	144	Low G value recorded	Replaced accelerometer cable; **removed center bolts on all three fixtures after it was determined that they were making contact with the cards.**
10	159	Corner of card broke off (screw location)	See photos below.

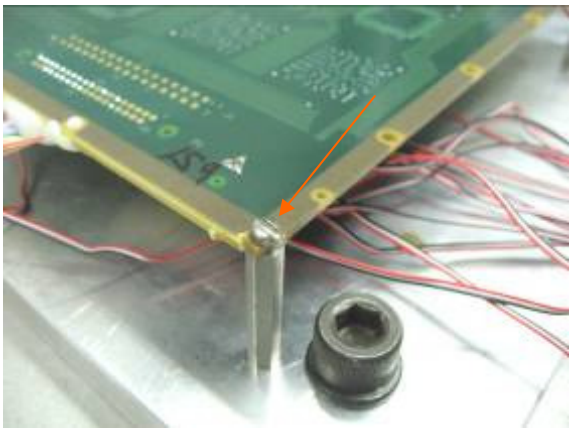


Figure 5: Broken card 159 after drop 10.

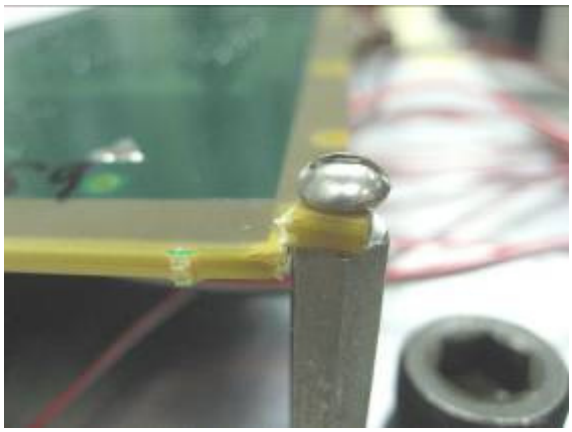


Figure 6: Close up of broken card 159.

6.1.2 Set 2: cards 26, 146, 187

	Table		Card 26		Card 146		Card 187 (strain gauged)	
Drop	**G's**	**ms**	**G's**	**ms**	**G's**	**ms**	**G's**	**ms**
1	485	1.96	1186	0.76	1690	0.64	1609	0.86
2	500	1.94	1167	0.76	1529	0.66	1419	0.80
3	499	1.94	1150	0.76	1575	0.64	1881	0.72
4	513	1.94	1149	0.78	1399	0.64	1781	0.72
5	519	1.94	1212	0.76	1547	0.58	1970	0.70
6	514	1.94	1193	0.76	1347	0.70	207	9.18
7	520	1.92	2352	0.36	1358	0.66	1223	0.84
8	519	1.92	2197	1.60	1333	0.68	1616	11.24
9	516	1.94	1223	0.76	2110	0.36	2973	9.22
10	508	1.94	1628	0.20	1468	0.60	1651	0.72

The following notes were taken during the drop testing. See Appendix B for response graphs.

Drop	Card	Issue	Notes / Action Taken
6	187	Low G value recorded	Checked accelerometer connection; replaced cable.
7	26	Accelerometer response	Consistent initial response; spike giving higher G's. Checked card on fixture.
8	26	Accelerometer response	Consistent initial response; spike giving higher G's. Checked card on fixture.
	187	Long duration recorded	Checked card on fixture; checked all cable connections.
9	187	Accelerometer response	Replaced accelerometer BP17 to PCB P357C10, 13850.

6.1.3 Set 3: cards 59, 147, 188

	Table		Card 147		Card 59		Card 188	
Drop	**G's**	**ms**	**G's**	**ms**	**G's**	**ms**	**G's**	**Ms**
1	503	1.94	1494	0.66	1720	0.70	1578	0.58
2	500	1.94	1249	0.82	1577	0.66	1582	0.56
3	507	1.94	1278	0.80	1454	0.68	1612	0.58
4	506	1.92	1236	0.80	1336	0.70	1627	0.60
5	509	1.94	1230	0.80	1371	0.70	1681	0.58
6	510	1.92	1186	0.78	1385	0.68	1678	0.56
7	512	1.94	1191	0.78	1377	0.68	1769	0.52
8	510	1.92	1155	0.80	1360	0.70	1764	0.54
9	513	1.92	1161	0.78	1352	0.68	1727	0.54
10	513	1.92	1194	0.48	1370	0.68	1838	0.54

See Appendix B for response graphs.

6.1.4 Set 4: cards 28, 77, 145

	Table		Card 145		Card 77		Card 28	
Drop	**G's**	**ms**	**G's**	**ms**	**G's**	**ms**	**G's**	**Ms**
1	497	1.98	1509	2.66	1325	0.66	1485	0.08
2	510	1.96	7	20	1383	0.60	1155	0.58
3	521	1.92	22	20	1314	0.60	1193	0.76
4	517	1.92	1262	0.62	1356	0.62	1127	0.76
5	508	1.94	1279	0.60	1354	0.62	1117	0.78
6	519	1.94	1279	0.62	1284	0.62	1160	0.78
7	514	1.94	1250	0.62	1397	0.60	1070	0.46
8	522	1.90	1268	0.60	1124	0.80	1127	0.78
9	519	1.92	1291	0.60	1271	0.58	1072	0.78
10	494	2.00	1258	0.60	1234	0.62	1013	0.78

The following notes were taken during the drop testing. See Appendix B for response graphs.

Drop	Card	Issue	Notes / Action Taken
1	145	Long duration recorded	Checked card on fixture.
	28	Short duration recorded	Checked card on fixture.
2	145	Low G value recorded	Checked accelerometer and all cable connections.
3	145	Low G value recorded	Replaced accelerometer BP17 with P357C10, 13850

6.1.5 Set 5: cards 25, 92, 186

	Table		Card 25 (strain gauged)		Card 186		Card 92	
Drop	**G's**	**ms**	**G's**	**ms**	**G's**	**ms**	**G's**	**Ms**
1	534	1.94	1524	0.70	10045	0.14	1325	0.78
2	532	1.94	1268	0.66	1483	0.56	1180	0.62
3	535	1.92	1301	0.54	1479	0.56	1102	0.80
4	521	1.98	1147	0.66	1460	0.56	2873	0.24
5	537	1.92	1135	0.52	1512	0.56	9804	0.12
6	518	1.98	1142	0.48	1474	0.58	10023	0.18
7	533	1.92	1258	1.14	1396	0.54	1745	0.76
8	538	1.92	1472	1.08	1473	0.54	10163	0.94
9	533	1.92	1220	1.08	1409	0.56	10103	0.14
10	539	1.92	1566	0.96	1499	0.56	n/a	n/a

The following notes were taken during the drop testing. See Appendix B for response graphs.

Drop	Card	Issue	Notes / Action Taken
1	186	High G value recorded	Checked accelerometer and all cable connections.
4	92	Accelerometer response	Consistent initial response; spike giving high G's. Checked card on fixture.
5	92	High G value recorded	Card cracked at mounting location - continued testing.
6	92	High G value recorded	Washer to help secure card.
8	92	High G value recorded	Due to crack in the card.
9	92	High G value recorded	Removed card for last drop.

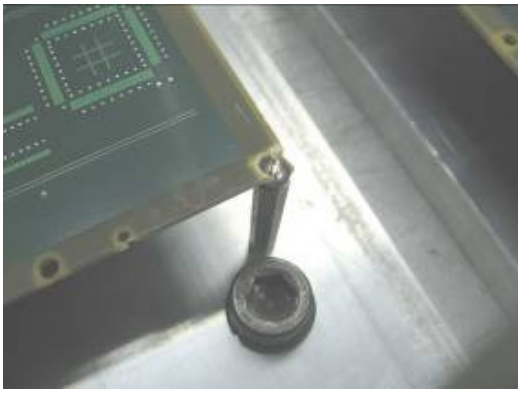


Figure 7: Cracked card 92.

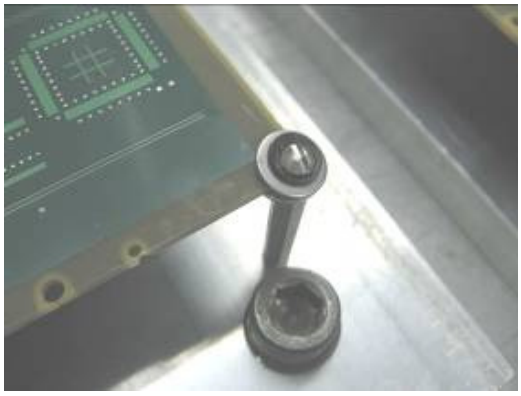


Figure 8: Washer to secure card.

6.1.6 Set 6: cards 29, 148, 184

	Table		Card 148 (strain gauged)		Card 29		Card 184	
Drop	**G's**	**ms**	**G's**	**ms**	**G's**	**ms**	**G's**	**ms**
1	532	1.92	1497	0.60	1329	0.76	10083	0.16
2	541	1.92	2845	0.70	1264	0.76	2769	1.38
3	539	1.90	2969	0.60	1262	0.74	1418	1.96
4	531	1.94	3415	0.58	1222	0.74	1506	1.90
5	544	1.90	3515	0.48	1254	0.76	1628	1.98
6	530	1.92	3725	0.48	1236	0.76	1623	1.82
7	539	1.92	4461	0.46	1176	0.76	1880	1.76
8	541	1.88	3981	0.44	1157	0.50	1890	1.76
9	539	1.92	4754	0.44	1161	0.48	3045	0.66
10	540	1.90	1681	9.28	1240	0.56	3109	0.64

The following notes were taken during the drop testing. See Appendix B for response graphs.

Drop	Card	Issue	Notes / Action Taken
1	184	High G value recorded	Checked card in fixture; all cable connections; better secured cable.
2	148, 184	Accelerometer response	Consistent initial response; spike giving higher G's. Checked cards on fixture.
3-8	148	Accelerometer response	Consistent initial response; spike giving higher G's. Checked card on fixture.
9-10	184	Accelerometer response	Consistent initial response; spike giving high G's. Checked card on fixture.
	148	Accelerometer response	Inconsistent readings. Checked accelerometer and all cable connections.

6.1.7 Set 7: cards 27, 58

	Table		Card 27		Card 58 (strain gauged)	
Drop	**G's**	**ms**	**G's**	**ms**	**G's**	**ms**
1	496	2.00	7	20.00	n/a	n/a
2	494	2.00	5	20.00	815	0.64
3	501	1.98	5	20.00	1113	0.78
4	518	1.96	2308	0.74	1127	0.78
5	499	1.98	4134	0.16	1047	0.78
6	502	1.98	10000	0.66	1069	0.78
7	508	1.96	10003	0.72	1193	1.06
8	498	2.02	1410	3.50	1230	1.16
9	517	1.94	10591	8.86	2644	0.82
10	521	1.96	10588	8.78	3221	0.80

The following notes were taken during the drop testing. See Appendix B for response graphs.

Drop	Card	Issue	Notes / Action Taken
1	27, 58	No accelerometer response	Checked accelerometer and all cable connections; checked software setup.
2	27	No accelerometer response	Checked accelerometer and all cable connections; checked software setup.
3	27	No accelerometer response	Checked accelerometer and all cable connections – replaced cable.
4	27	Accelerometer response	Consistent initial response; spike giving high G's. Checked card on fixture.
5	27	Accelerometer response	Consistent initial response; spike giving high G's.
6	27	Accelerometer response	Inconsistent readings. Checked accelerometer and all cable connections.
7	27	Accelerometer response	Inconsistent readings. Changed accelerometer to PCB P357C10, 13850.
8	27, 58	Accelerometer response	Consistent initial response; spike giving high G's.
9	27, 58	Accelerometer response	Consistent initial response; spike giving high G's.
10	27, 58	Accelerometer response	Consistent initial response; spike giving high G's.

7. PRINCIPAL STRAIN

7.1 Strain Gauge Attachment

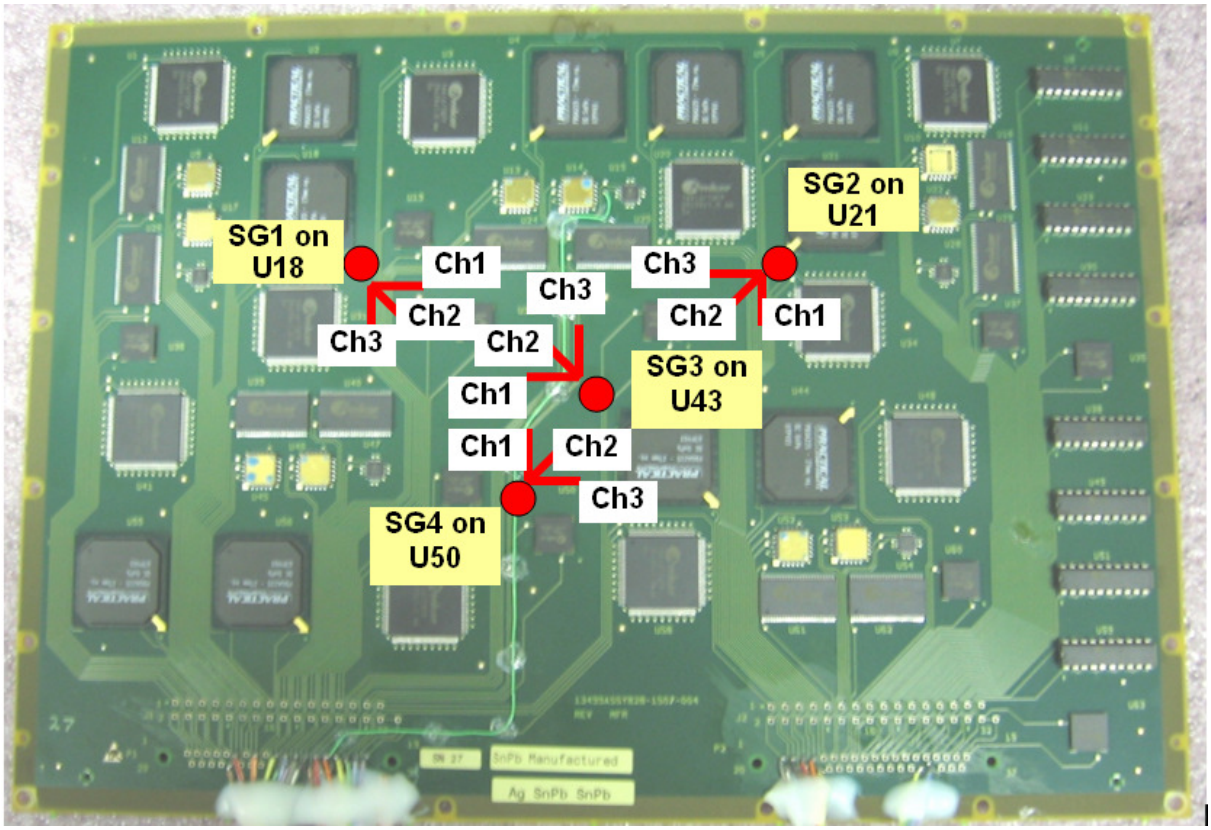


Figure 9: Strain Gauge Attachment

Cards 159, 187, 25, 148 and 58 were dropped with shock, resistance and strain monitoring. Four rosette strain gauges were attached on each board and the strain gauges locations are given above. Each strain gauge has 3 channels and the principal strain was calculated using the strain reading from these channels.

7.2 Strain System and Test Procedure

A Vishay Measurements group system 6000 Model 6100 was used for the strain measurements. After strain gage attachment the test boards were mounted on the drop test fixtures (upside down) which were bolted to the drop table. All four strain gauges were linked to the measurement system by using 12 adaptors. The boards were then monitored in-situ for strain, shock and resistance during the drop test.

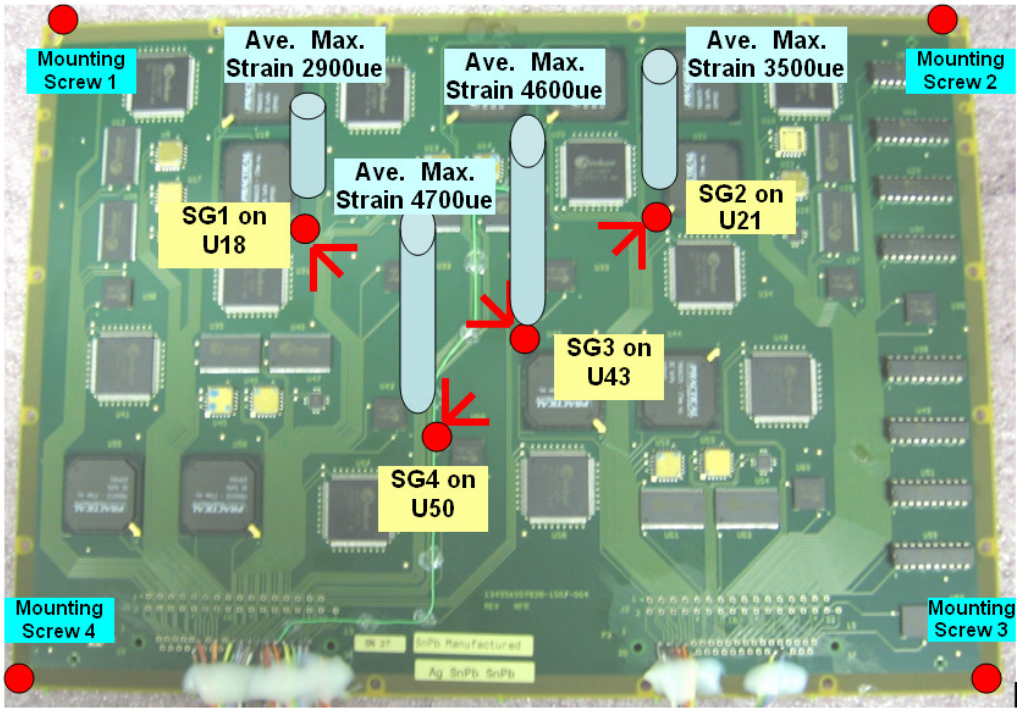


Figure 10: Average Maximum Strain at each Strain Gauge

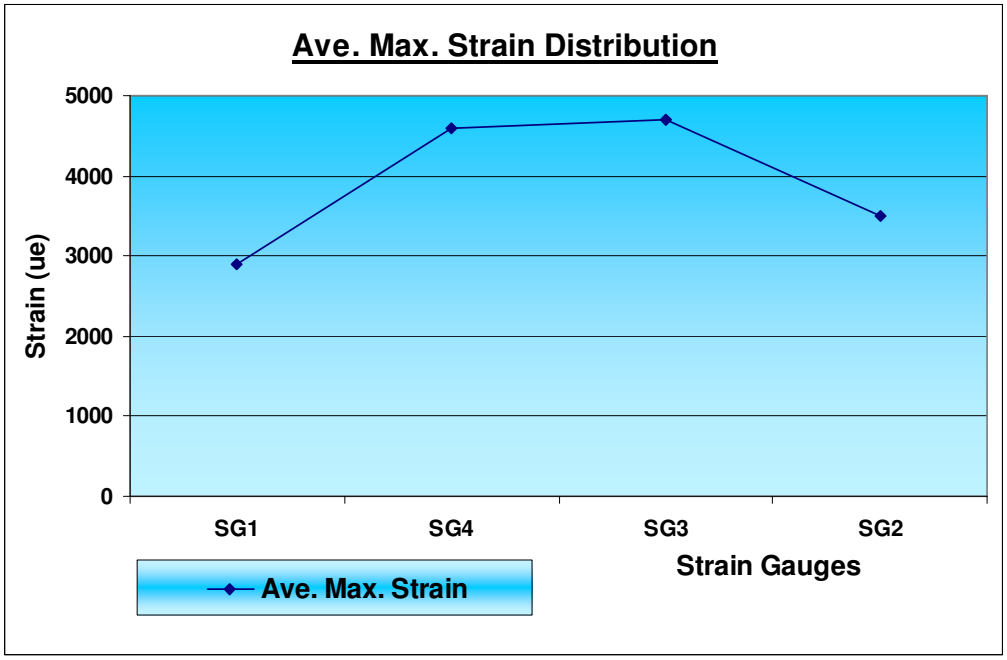


Figure 11: : Average Maximum Strain at each Strain Gauge

7.3 Principal Strain Summary: card 159 (drop set 1)

	Strain Gauge 1				Strain Gauge 2			
	Principal strain1(ue)		Principal strain 2(ue)		Principal strain1(ue)		Principal strain 2(ue)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Card 159_500G_1	-432.9	3291.4	-1877.6	1283.0	-259.5	3231.7	-2026.3	549.0
Card 159_500G_2	-467.2	3519.9	-1932.5	1298.0	-218.5	3262.9	-2150.7	546.9
Card 159_500G_3	-543.7	3576.4	-1837.2	1346.9	-205.5	3170.2	-2226.8	610.1
Card 159_500G_4	-547.7	3573.1	-1748.0	1335.3	-199.2	3227.9	-2030.7	610.3
Card 159_500G_5	-462.2	3570.6	-1725.9	1293.5	-197.6	3261.7	-2113.8	612.6
Card 159_500G_6	-456.0	3530.1	-1879.4	1275.6	-207.2	3206.2	-1940.7	603.8
Card 159_500G_7	-680.2	2684.4	-1848.0	714.7	-175.0	3169.1	-1729.1	355.8
Card 159_500G_8	-747.3	2790.0	-1940.5	818.9	-183.4	3323.6	-1835.0	447.3
Card 159_500G_9	-617.7	2951.2	-1615.8	903.8	-179.6	3410.2	-1662.4	429.4
Card 159_500G_10	-333.7	2842.1	-1530.5	1223.5	-168.1	2909.5	-1788.3	550.1

	Strain Gauge 3				Strain Gauge 4			
	Principal strain1(ue)		Principal strain 2(ue)		Principal strain1(ue)		Principal strain 2(ue)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Card 159_500G_1	-370.4	3608.5	-2522.2	864.5	1188.2	4685.6	-3491.2	-758.0
Card 159_500G_2	-484.8	3258.2	-3193.1	857.7	-141.8	3937.3	-2289.9	525.3
Card 159_500G_3	-401.0	3381.2	-3157.4	822.8	-184.6	3910.1	-2152.4	509.4
Card 159_500G_4	-410.6	3263.4	-2927.6	828.4	-200.4	4001.5	-2196.0	493.4
Card 159_500G_5	-384.1	3255.3	-3052.1	823.4	-208.8	3948.3	-2160.1	507.6
Card 159_500G_6	-310.6	3177.9	-2916.7	758.8	-202.0	3977.7	-2230.2	492.0
Card 159_500G_7	-227.1	4530.5	-2198.6	851.7	-125.9	4521.5	-2267.2	512.8
Card 159_500G_8	-137.5	4714.5	-2342.3	834.5	-97.1	4758.6	-2391.8	509.5
Card 159_500G_9	-246.7	4829.5	-2481.6	758.6	-107.7	4794.8	-2559.5	503.4
Card 159_500G_10	-144.8	4279.2	-1528.3	892.6	-80.3	4056.9	-1966.9	557.0

7.4 Principal Strain Summary: card 187 (drop set 2)

	Strain Gauge 1				Strain Gauge 2			
	Principal strain1(ue)		Principal strain 2(ue)		Principal strain1(ue)		Principal strain 2(ue)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Card 187_500G_1	-319.9	2978.2	-2087.2	415.6	-250.9	3255.5	-1811.3	584.5
Card 187_500G_2	-355.7	2780.5	-1985.4	357.5	-255.6	3374.2	-1848.3	560.3
Card 187_500G_3	-331.2	2815.1	-1627.4	366.2	-273.4	3423.0	-1696.5	436.6
Card 187_500G_4	-369.4	2772.8	-2142.4	386.7	-267.5	3423.2	-1948.7	395.7
Card 187_500G_5	-327.1	2811.0	-1936.5	367.4	-292.0	3535.5	-1861.0	438.2
Card 187_500G_6	-341.7	2856.9	-1906.2	351.3	-325.6	3494.4	-1940.5	344.0
Card 187_500G_7	-362.3	2793.1	-2390.1	326.6	-310.2	3519.8	-2046.1	381.3
Card 187_500G_8	-414.8	2859.9	-2359.7	324.2	-305.7	3555.3	-1955.6	459.7
Card 187_500G_9	-362.3	2822.0	-2326.8	338.7	-334.6	3590.8	-1987.5	385.7
Card 187_500G_10	-375.5	2840.4	-2392.9	330.8	-297.3	3558.0	-1975.7	447.9

	Strain Gauge 3				Strain Gauge 4			
	Principal strain1(ue)		Principal strain 2(ue)		Principal strain1(ue)		Principal strain 2(ue)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Card 187_500G_1	-145.5	4558.2	-2071.2	835.3	-117.2	4768.1	-2133.1	501.7
Card 187_500G_2	-153.2	4629.9	-2400.5	754.7	-135.6	4778.5	-2504.0	527.1
Card 187_500G_3	-153.1	4631.3	-2301.7	755.2	-109.0	4869.4	-2448.1	499.0
Card 187_500G_4	-164.5	4611.8	-2401.6	612.6	-133.6	4801.2	-2481.5	506.7
Card 187_500G_5	-163.5	4732.3	-2356.9	640.5	-117.3	5003.2	-2436.4	518.7
Card 187_500G_6	-153.2	4636.7	-2366.0	660.5	-117.0	5024.3	-2429.6	534.5
Card 187_500G_7	-197.4	4608.6	-2116.9	700.2	-160.7	4854.4	-2190.0	545.5
Card 187_500G_8	-136.8	4613.1	-2159.9	558.2	-135.9	4897.6	-2230.2	545.9
Card 187_500G_9	-158.5	4591.1	-2192.4	620.2	-133.8	4844.1	-2286.7	547.0
Card 187_500G_10	-145.4	4541.6	-2235.3	596.1	-153.0	4889.4	-2269.0	534.8

7.5 Principal Strain Summary: card 25 (drop set 5)

	Strain Gauge 1				Strain Gauge 2			
	Principal strain1(ue)		Principal strain 2(ue)		Principal strain1(ue)		Principal strain 2(ue)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Card 25_500G_1	n/m	n/m	n/m	n/m	-170.4	3307.0	-1670.8	513.6
Card 25_500G_2	n/m	n/m	n/m	n/m	-189.9	3451.9	-1850.4	418.2
Card 25_500G_3	n/m	n/m	n/m	n/m	-171.3	3332.8	-1788.7	356.9
Card 25_500G_4	-346.1	2775.2	-1814.4	449.5	-213.6	3416.7	-1975.2	387.0
Card 25_500G_5	-333.9	2842.8	-1862.0	482.1	-199.6	3570.0	-2001.2	405.6
Card 25_500G_6	-341.0	2866.7	-1867.1	509.1	-197.9	3564.3	-2047.9	402.6
Card 25_500G_7	-370.5	2909.0	-2002.3	554.1	-228.2	3665.1	-1942.0	442.0
Card 25_500G_8	-351.6	2932.8	-1854.4	484.7	-196.1	3823.1	-1770.9	451.7
Card 25_500G_9	-376.5	2933.9	-1919.1	495.9	-227.2	3831.9	-1754.7	425.9
Card 25_500G_10	-379.8	2847.9	-1801.9	496.4	-206.6	4273.2	-1743.3	425.8

n/m: Not measured. One of the 3 channels of strain gauge1 had false reading, so that the principal strain couldn't be calculated.

	Strain Gauge 3				Strain Gauge 4			
	Principal strain1(ue)		Principal strain 2(ue)		Principal strain1(ue)		Principal strain 2(ue)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Card 25_500G_1	-146.6	4678.5	-2076.6	907.2	-132.8	4935.2	-2345.9	619.6
Card 25_500G_2	-159.8	4905.2	-2316.3	831.6	-153.4	5148.0	-2525.3	576.0
Card 25_500G_3	-170.2	4874.3	-2315.3	816.2	-297.4	5075.1	-2560.4	459.3
Card 25_500G_4	-165.2	4931.7	-2480.8	779.0	-237.5	5081.2	-2694.6	519.1
Card 25_500G_5	-141.0	4826.6	-2524.7	782.2	-210.9	5024.4	-2750.5	608.9
Card 25_500G_6	-218.8	4792.4	-2574.9	770.8	-188.4	5134.0	-2795.2	747.6
Card 25_500G_7	-134.0	4569.0	-2413.0	800.0	-135.8	4968.0	-2584.3	463.1
Card 25_500G_8	-133.4	4396.0	-2312.5	794.1	-194.0	4885.4	-2485.0	474.5
Card 25_500G_9	-202.1	4341.4	-2282.4	765.5	-215.3	4758.1	-2486.6	626.7
Card 25_500G_10	-190.2	4263.2	-2239.8	779.0	-185.9	4808.5	-2406.2	531.5

7.6 Principal Strain Summary: card 148 (drop set 6)

	Strain Gauge 1				Strain Gauge 2			
	Principal strain1(ue)		Principal strain 2(ue)		Principal strain1(ue)		Principal strain 2(ue)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Card 148_500G_1	-395.7	2801.0	-1824.4	484.6	-224.5	3303.8	-1722.4	409.1
Card 148_500G_2	-442.4	3038.6	-1887.7	449.5	-264.1	3381.1	-1890.2	380.3
Card 148_500G_3	-427.2	3058.8	-1765.7	453.1	-293.1	3449.2	-1910.8	447.0
Card 148_500G_4	-434.3	3174.9	-1700.3	421.8	-293.8	3590.5	-1929.3	309.3
Card 148_500G_5	-408.9	3281.9	-1744.5	455.3	-261.7	3643.1	-1913.6	316.5
Card 148_500G_6	-419.8	3258.2	-1726.9	432.7	-272.4	3608.0	-1927.5	372.2
Card 148_500G_7	-438.2	3330.3	-1720.6	442.2	-251.5	3598.0	-1905.6	391.5
Card 148_500G_8	-486.0	3295.0	-1756.1	453.5	-233.0	3575.2	-1938.2	337.8
Card 148_500G_9	-483.6	3321.5	-1742.7	433.4	-288.0	3607.3	-1945.0	394.0
Card 148_500G_10	-408.9	3392.0	-1824.6	454.3	-279.2	3705.9	-1931.5	295.5

	Strain Gauge 3				Strain Gauge 4			
	Principal strain1(ue)		Principal strain 2(ue)		Principal strain1(ue)		Principal strain 2(ue)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Card 148_500G_1	-143.6	4738.8	-2201.9	552.3	-142.0	4216.1	-1890.6	793.4
Card 148_500G_2	-134.5	4766.0	-2372.6	542.6	-134.1	4088.0	-1975.9	698.0
Card 148_500G_3	-128.4	4836.0	-2417.2	578.0	-131.9	4121.3	-2010.8	691.1
Card 148_500G_4	-137.0	4814.0	-2442.2	581.6	-158.3	4168.6	-2056.2	672.0
Card 148_500G_5	-182.4	5031.9	-2437.9	618.4	-182.7	4272.9	-2098.0	670.7
Card 148_500G_6	-217.5	4946.8	-2441.6	638.4	-187.6	4206.1	-2128.2	655.6
Card 148_500G_7	-228.8	4871.7	-2326.3	654.6	-186.4	4232.3	-2034.7	664.6
Card 148_500G_8	-225.2	5012.5	-2221.1	657.1	-164.3	4175.2	-1988.1	661.9
Card 148_500G_9	-260.4	4987.1	-2200.9	642.9	-171.8	4112.7	-1993.3	661.1
Card 148_500G_10	-211.7	4894.0	-2432.1	620.4	-209.1	4029.1	-2180.3	654.5

7.7 Principal Strain Summary: card 58 (drop set 7)

	Strain Gauge 1				Strain Gauge 2			
	Principal strain1(ue)		Principal strain 2(ue)		Principal strain1(ue)		Principal strain 2(ue)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Card 58_500G_1	-355.2	2342.4	-1557.5	409.8	-285.9	3546.2	-2050.9	507.9
Card 58_500G_2	-359.9	2368.6	-1714.7	399.4	-338.0	3769.3	-2321.3	516.2
Card 58_500G_3	-353.7	2387.9	-1740.0	391.8	-340.2	3792.0	-2408.0	501.3
Card 58_500G_4	-367.3	2425.0	-1793.2	389.2	-361.7	3820.0	-2471.1	481.4
Card 58_500G_5	-387.9	2444.7	-1822.8	377.0	-375.9	3916.7	-2471.6	493.9
Card 58_500G_6	-393.4	2477.7	-1906.1	350.0	-356.7	3896.4	-2516.4	495.7
Card 58_500G_7	-369.8	2500.5	-1791.5	336.5	-394.1	4037.9	-2361.2	453.4
Card 58_500G_8	-410.5	2542.9	-1689.2	310.0	-434.2	3945.2	-2192.1	454.3
Card 58_500G_9	-358.9	2556.7	-1672.3	365.6	-398.7	4100.2	-2173.1	483.9
Card 58_500G_10	-375.1	2584.6	-1923.1	344.1	-396.8	4183.9	-2559.4	450.5

	Strain Gauge 3				Strain Gauge 4			
	Principal strain1(ue)		Principal strain 2(ue)		Principal strain1(ue)		Principal strain 2(ue)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Card 58_500G_1	-113.3	4601.7	-2207.3	803.9	-89.5	4899.8	-2477.6	568.3
Card 58_500G_2	-159.8	4941.8	-2430.0	749.9	-126.3	5249.1	-2672.1	534.1
Card 58_500G_3	-177.4	4957.3	-2508.0	742.0	-165.0	5292.1	-2736.4	534.8
Card 58_500G_4	-213.7	4998.2	-2532.9	737.6	-192.9	5302.1	-2751.9	527.0
Card 58_500G_5	-217.2	4926.5	-2468.7	726.0	-196.4	5292.7	-2613.5	494.4
Card 58_500G_6	-269.8	4959.9	-2449.1	709.2	-193.3	5263.4	-2561.2	514.9
Card 58_500G_7	-247.0	4936.9	-2284.1	675.7	-202.8	5344.7	-2397.8	528.6
Card 58_500G_8	-306.6	4932.1	-2206.0	657.9	-203.3	5269.9	-2331.9	517.1
Card 58_500G_9	-251.5	4859.2	-2134.1	689.2	-251.8	5334.1	-2185.7	525.1
Card 58_500G_10	-234.8	4797.9	-2497.6	694.1	-206.4	5323.6	-2590.8	544.9

8. COMPONENT RESISTANCE

8.1 Event Detector

At the Customer's request, only 24 of the 63 components on each board were monitored using an Event Detector. Twenty boards in total were dropped. Each drop set included three boards (only two boards on the last drop). The Event Detector was set to record data in 1 minute cycles, recording 30 times per cycle. Thus, the Event Detector polled for events every 2 seconds. The Event Detector failure threshold was set to 300 ohms. The maximum occurrence limit was NOT selected. As a result, this generated a maximum of 15 failure readings for each cycle. Due to a board fabrication/design error, a wire-add was soldered onto the board to complete the U15 net. An image of the wiring can be seen in Figure 12 below.

Figure 12: Image of wiring connections to the event detector.

8.2 Resistance Measurement Procedure

The boards were attached to the drop table and connected to the Event Detector. A half-inch braided strap was connected to the Table, Event Detector and Strain monitoring system ground connections. The table was raised and the Accelerometer, Strain and Event Detector systems started. The Event Detector was operating one cycle at a time, to correspond with the drop count. The table was then dropped. Any component failures recorded by the Event Detector were hand measured using a digital multi-meter to confirm the failure. When possible the failure locations were isolated. The failure point was determined based on when the event detector recorded an event and when during verification the component resistance increased by more than 0.2 ohms from the initial measurement. Based on this failure definition, it is possible that the boards experienced a pad crater fault which although detected by the event detector did not result in a resistance increase at steady state and as such was ignored.

8.3 Individual Component Observations:

Interpretation notes for the data tables:

- All green shaded cells marked with 11's imply that the part survived 10 drops.
- All red shaded cells marked with numbers imply that the part was confirmed failed at the drop number listed.
- The blue shaded cells marked with 9's imply that the part survived 9 drops. The 10th drop was cancelled because the tooling holes in the card failed.
- The grey shaded cells with no number imply that the part is shown in a different section, i.e. As assembled, rework x1, rework x2, rework x3 or was a time zero fail.
- The purple shaded cell marked with an 11 was a TSOP-50 time zero failure (pins 25-26 open). The rest of the leads survived 10 drops.

8.3.1 Component BGA-225

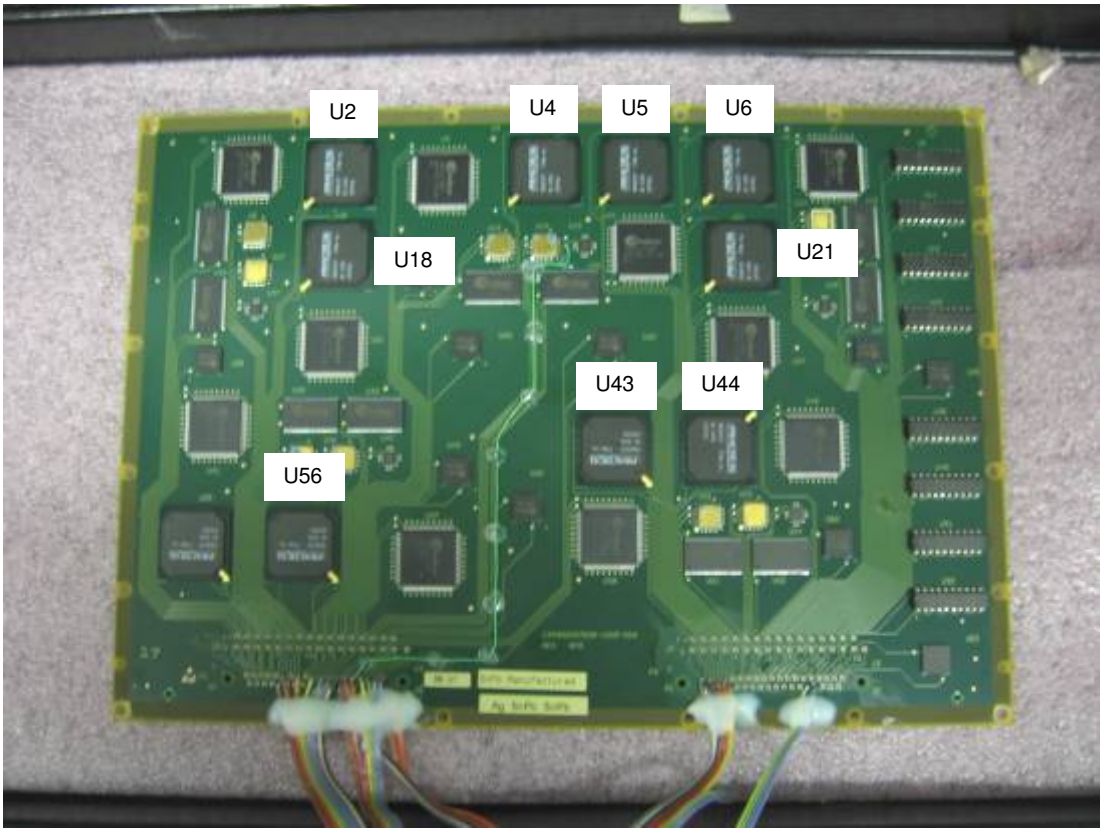


Figure 13: Location of the BGA-225 parts that were monitored.

Table 7.3 : Record of drops to failure for the BGA-225, as assembled parts.

		U2	U4	U5	U6	U18	U21	U43	U44	U56
As Assembled	ImmAg-SnPb	11	6	4	4	11	6	8	11	11
		11	5	3	3	11	5	6	11	11
		10	5	3	3	11	4	6	11	11
		10	5	3	3	10	3	5	11	10
		8	5	3	2	5	3	5	10	8
			5	3					8	
			4	3					7	
			4	2					7	
			2	2					4	
			1	2					3	
	ImmAg-SAC305	11	6	4	3	11	9	7	11	11
		11	5	4	3	11	5	6	11	10
		9	5	3	3	11	4	5	11	9
		8	3	3	2	9	2	4	11	7
		7	3	3					9	
			3	2					8	
			2	2					7	
			2	2					6	
			2	2					6	
	ENIG-SnPb		2	2					2	

Table 7.2 : Record of drops to failure for the BGA-225, Rework x 1 parts.

		U2	U4	U5	U6	U18	U21	U43	U44	U56
Rework x1 time	ImmAg-SnPb	11			3	11	5	4		11
		11			2	11	4	3		10
		4			2	5	4	1		10
		3			2	4	3	1		7
		2			1	3	2			
	ImmAg-SAC305							3		
								3		
								2		
								2		
								1		
	ENIG-SnPb	6			2	3	5	1		4

Table 7.3 : Record of drops to failure for the BGA-225, Rework x 2 parts.

		U2	U4	U5	U6	U18	U21	U43	U44	U56
Rework x2 times	ImmAg-SnPb									11
	ImmAg-SAC305	3			2	10	5			8
					2	6	2			5
					2	6	1			
					2	4				

Table 7.4 : Record of drops to failure for the BGA-225, Rework x 3 parts.

		U2	U4	U5	U6	U18	U21	U43	U44	U56
Rework x3 times	ImmAg-SAC305	4			2	3	1			3
		2					1			

General Observations PBGA-225:

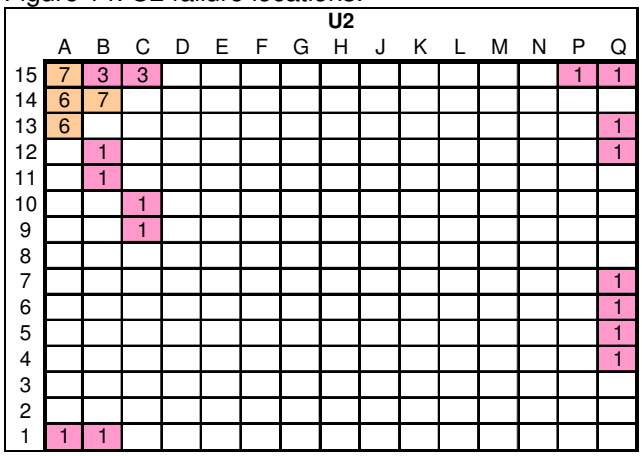
- Most failures occurred on or near the corners.
- Some of the BGAs near the outer edge of the board survived 10 drops.
- The SnPb and SAC305 on ImmAg were similar but the ENIG finish was worse.
- Most rework parts were worse than the as assembled parts.
- The 1, 2, and 3 times reworks appear to fail at the same rate.

Table 7.5: Legend of the PBGA225 failure mappings

Legend	
Code	**# Fails**
	0
	1-4
	5-8
	9-12
	13-16
	17-20

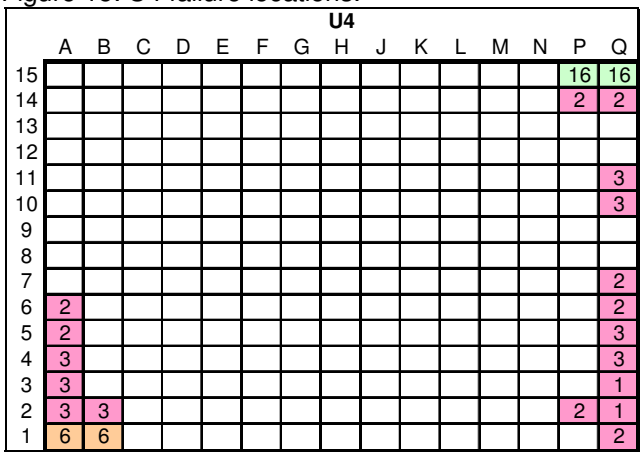
The following figures show the location of the initial electrical failures for the various PBGA225 components. The diagrams are viewed from the top side of the board with the top of the diagram orientated to the top of the board. The A1 location varies and should be noted.

Figure 14: U2 failure locations.



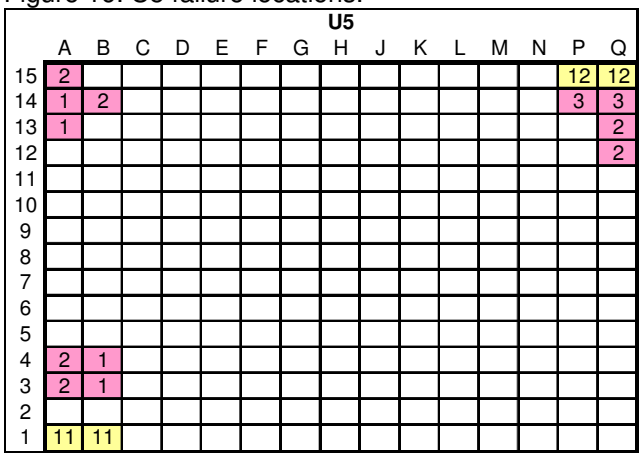
U2	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q
15	7	3	3											1	1
14	6	7													
13	6														1
12		1													1
11		1													
10			1												
9			1												
8															
7															1
6															1
5															1
4															1
3															
2															
1	1	1													

Figure 15: U4 failure locations.



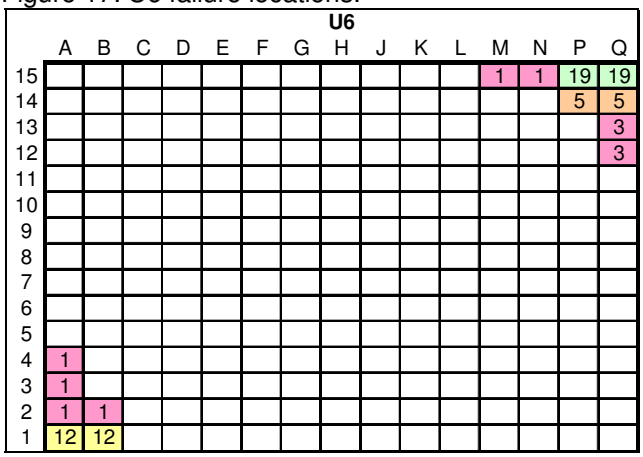
U4	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q
15														16	16
14														2	2
13															
12															
11															3
10															3
9															
8															
7															2
6	2														2
5	2														3
4	3														3
3	3														1
2	3	3												2	1
1	6	6													2

Figure 16: U5 failure locations.



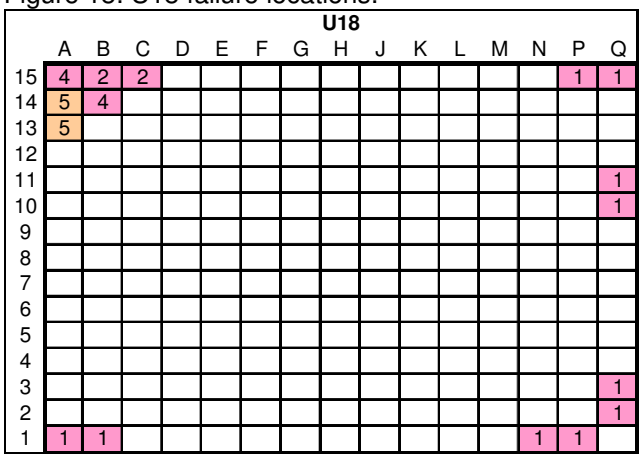
U5	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q
15	2													12	12
14	1	2												3	3
13	1														2
12															2
11															
10															
9															
8															
7															
6															
5															
4	2	1													
3	2	1													
2															
1	11	11													

Figure 17: U6 failure locations.



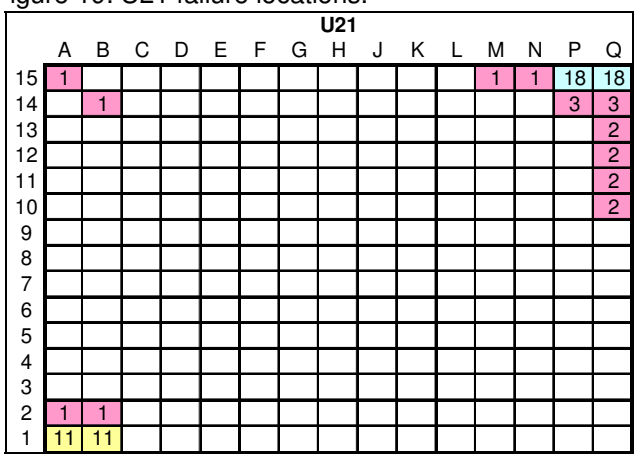
U6	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q
15												1	1	19	19
14														5	5
13															3
12															3
11															
10															
9															
8															
7															
6															
5															
4	1														
3	1														
2	1	1													
1	12	12													

Figure 18: U18 failure locations.



U18	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q
15	4	2	2											1	1
14	5	4													
13	5														
12															
11															1
10															1
9															
8															
7															
6															
5															
4															
3															1
2															1
1	1	1											1	1	

Figure 19: U21 failure locations.



U21	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q
15	1											1	1	18	18
14		1												3	3
13															2
12															2
11															2
10															2
9															
8															
7															
6															
5															
4															
3															
2	1	1													
1	11	11													

Figure 20: U43 failure locations.

U43

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Q	4						1	1	1	1	2	2	2	2	1
P	4													1	
N															
M													1		
L													1		
K															
J															
H												1			
G												1			
F												1			
E												1			
D													1		
C										1	1		1		
B												1	1		15
A		1	1	1	1										15

Figure 21: U44 failure locations.

U44

	Q	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1	2	1	1											1	1
2		2													
3															
4															
5															
6	1														
7	1														
8															
9															1
10															1
11															
12															
13															1
14														2	1
15	6	6											1	1	2

Figure 22: U56 failure locations.

U56

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Q									1	1	1	1	2	2	5
P					1	1			1	1	1	1	1	5	2
N									1	1	1	1		1	2
M									1	1					
L											1				
K										1					1
J															1
H															1
G															1
F						1						1			
E					1							1			
D															2
C															2
B		5													2
A	5	2	2												2

8.3.2 Component CABGA-100

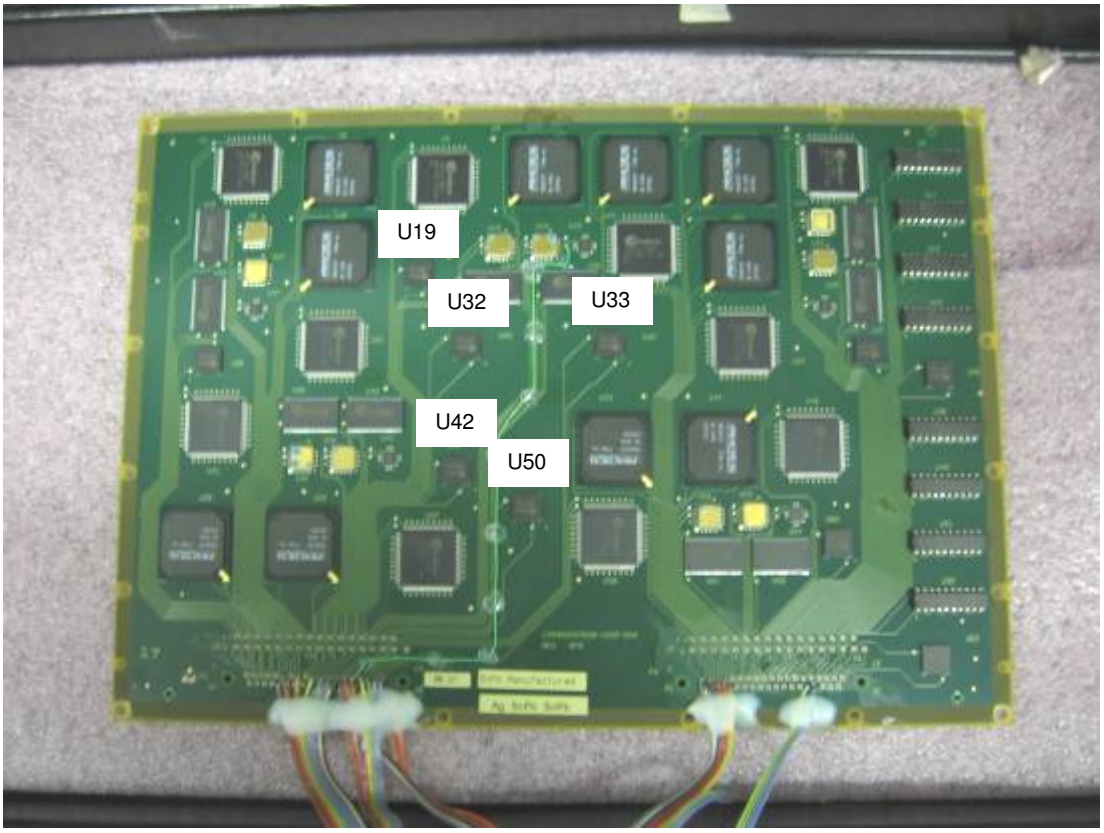


Figure 23: Location of the CABGA-100 parts that were monitored.

The CABGA-100 parts had a design error which resulted in the outside connections of the part being shorted in a parallel configuration. As such the internal nets of the part were not monitored during the test. See Figure 7.13 below.

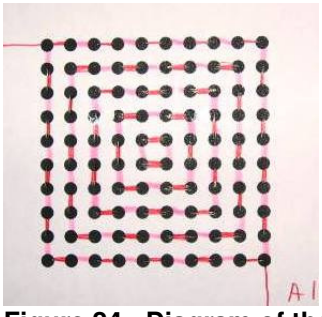


Figure 24: Diagram of the CABGA-100 daisy chain (red ink board trace, pink hi-liter component connection).

Table 7.6 : Record of drops to failure for the CABGA-100, as assembled parts.

		U19	U32	U33	U42	U50
As Assembled	ImmAg-SnPb	11	11	11	11	11
		11	11	11	11	11
		11	11	11	11	11
		11	11	11	11	11
		11	11	11	11	11
			11			
			11			
			11			
			11			
			11			
	ImmAg-SAC305	11	11	11	11	11
		11	11	11	11	11
		11	11	11	11	11
		9	11	9	9	11
			11			9
			11			
			11			
			11			
			9			
	ENIG-SnPb		11			

Table 7.7 : Record of drops to failure for the CABGA-100, Rework x1 parts.

		U19	U32	U33	U42	U50
Rework x1 time	ImmAg-SnPb	11		11	11	11
		11		11	11	11
		11		11	11	11
		11		11	11	11
		11		11	11	11
	ImmAg-SAC305	11		11	11	11
		11		11	11	11
		11		11	11	11
		11		11	11	11
		11			11	
	ENIG-SnPb	11		11	11	11

Table 7.8 : Record of drops to failure for the CABGA-100, Rework x2 parts.

		U19	U32	U33	U42	U50
Rework x2 times	ImmAg-SAC305			11		

General Observations CABGA-100:

- The outside connections of this part were shorted in a parallel configuration. This resulted in the internal nets of the part not being monitored).
- None of the CABGA-100 parts failed during the 10 drops.
- No differences seen between the rework and the as assembled parts.

8.3.3 Component TQFP-144

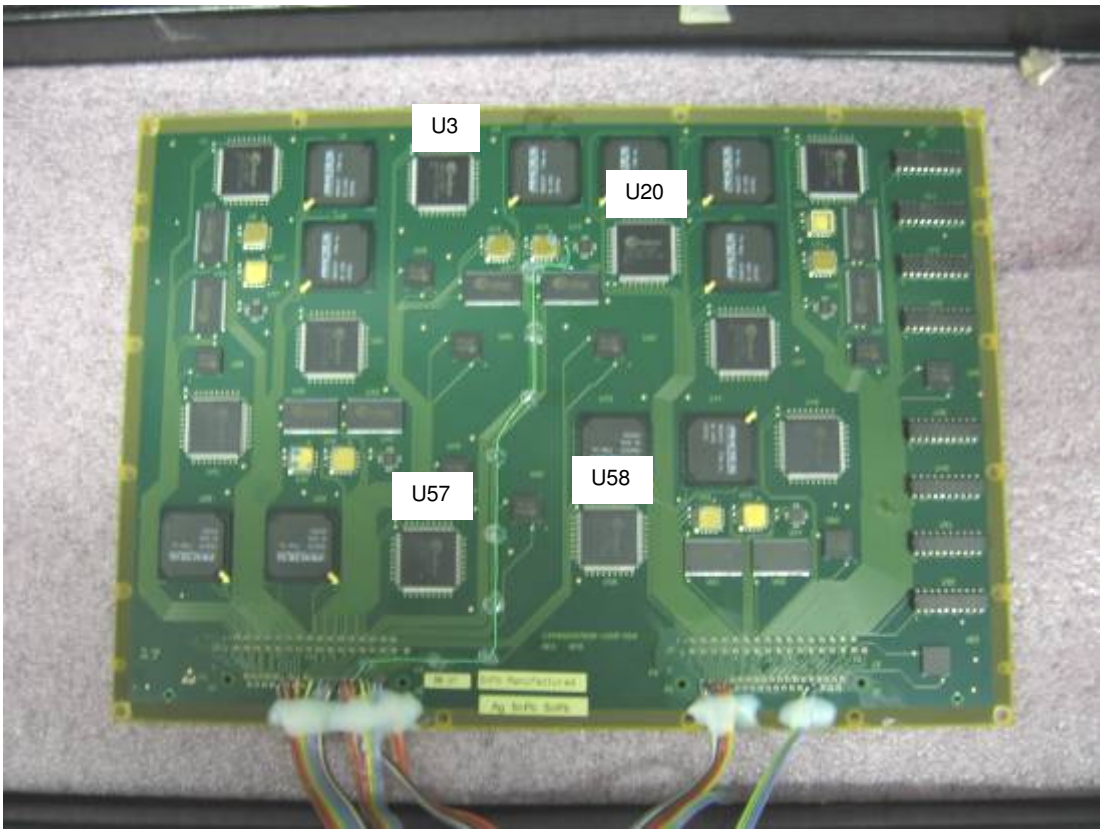


Figure 25: Location of the TQFP-144 parts that were monitored.

Table 7.9 : Record of drops to failure for the TQFP-144, as assembled parts.

		U3	U20	U57	U58
As Assembled	ImmAg-SnPb	11	11	11	11
		11	11	11	11
		11	11	11	11
		11	11	11	11
		11	11	11	11
		11	11	11	11
		11	11	11	11
		11	11	11	11
		11	11	11	11
		11	11	11	11
	ImmAg-SAC305	11	11	11	11
		11	11	11	11
		11	11	11	11
		11	11	11	11
		11	11	11	11
		11	11	11	11
		11	9	11	9
		11	7	11	
		9		9	
	ENIG-SnPb	11	11	11	11

General Observations TQFP-144:

- The U20 part failed at pins 85-86 (Marked as touch-up).
- All other parts survived the 10 drops.

8.3.4 Component TSOP-50

Figure 26: Location of the TSOP-50 parts that were monitored.

Table 7.10 : Record of drops to failure for the TSOP-50, as assembled parts.

		U24	U25
As Assembled	ImmAg-SnPb	11	11
		11	11
		11	11
		11	11
		11	11
	ImmAg-SAC305	11	11
		11	11
		11	9
		9	
	ENIG-SnPb	11	11

Table 7.11 : Record of drops to failure for the TSOP-50, Rework x1 parts.

		U24	U25
Rework x1 time	ImmAg-SnPb	11	11
		11	11
		11	11
		11	11
		11	11
	ImmAg-SAC305	11	11
		11	11
		11	11
		11	11
		11	11
			11

General Observations TSOP-50:

- None of the TSOP-50 parts failed during the 10 drops.
- No differences seen between rework and as assembled parts.

8.3.5 Component CLCC-20

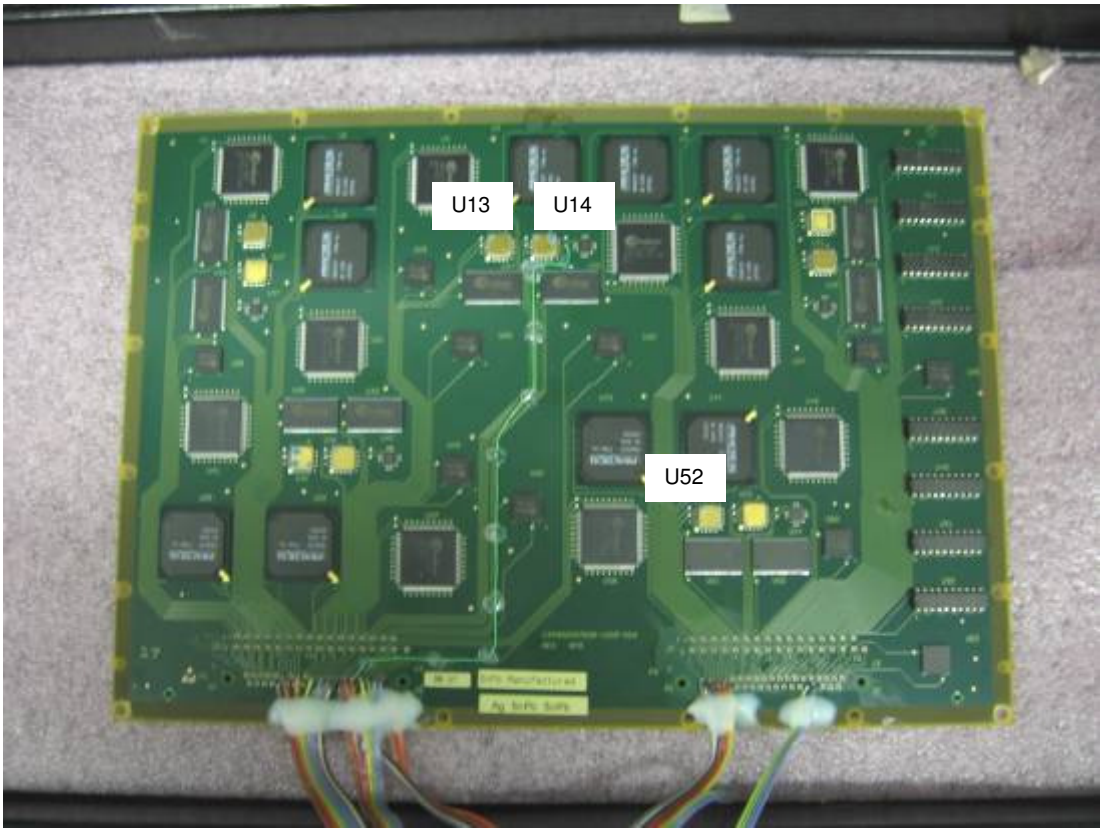


Figure 27: Location of the CLCC-20 parts that were monitored.

Table 7.12 : Record of drops to failure for the CLCC-20, as assembled parts.

		U13	U14	U52
As Assembled	ImmAg-SnPb	11	11	11
		11	11	11
		11	11	11
		11	11	11
		11	11	11
		11	11	11
		11	11	11
		11	11	11
		11	11	11
		8	4	11
	ImmAg-SAC305	11	11	11
		11	11	11
		11	11	11
		11	11	11
		11	11	11
		11	11	11
		11	11	11
		11	9	11
		9	6	9
	ENIG-SnPb	11	11	11

General Observations CLCC-20:

- The U13 parts failed at pins 1-2 [ImmAg-SnPb].
- The U14 parts failed at pins 3-4 [ImmAg-SnPb] and pins 1-2, 3-4, 5-6 [ImmAg-SAC305].

8.3.6 Component QFN-20

Figure 28: Location of the QFN-20 parts that was monitored.

Table 7.13: Record of drops to failure for the QFN-20, as assembled parts.

		U15
As Assembled	ImmAg-SnPb	11
		11
		11
		11
		11
		11
		11
		11
		11
		11
	ImmAg-SAC305	11
		11
		11
		11
		11
		11
		11
		11
		9
	ENIG-SnPb	11

General Observations QFN-20:

- None of the QFN-20 parts failed during the 10 drops.
- No differences seen between the board and paste types.

Testing Observations

- Setting the Event Detector to match the cycle count to the drop count was very useful in keeping the data aligned.
- It is best to start the event detector and wait about 10 seconds before doing the drop. This should help to eliminate noise/cable issues from the drop failures. Record the time interval that the drop occurred in the test log. If the event detector data shows a failure that matches the time interval when the drop occurred it is most likely a true electrical fail. If the failure is before or after the drop it most likely is noise.
- It is very important to isolate the failures when they occur. This will greatly reduce the amount of Failure Analysis required.
- Care must be taken when attaching the strain gauges. The sanding of the board resulted in broken traces.
- It would be best to connect the cables to the bottom side of the board, as the board is placing component side down on the drop table. This will make checking/repairing cable failures easier.

9. CONTRACTUAL STATEMENTS

Deviation from the documented procedure? (Yes/No) Yes

If Yes, state deviation:

Twenty cards were tested instead of twenty-one. Cards 55 and 57 could not be properly secured to the fixture (cards were cut too close to the mounting holes). Card 58 from the same group (Batch F – Imm. Ag) was used as a replacement.

Has any tests or documentation related to this report been subcontracted? No

If Yes, state work subcontracted:

Results in the report relate only to the item tested.

Tests and measurements stated in this report are performed within the precision of the Standards and Equipment listed.

10. APPENDIX A: Test Setup Photos

10.1 Test Fixtures

Each fixture is made from ¾" thick Al, with 1-½" SS standoffs.

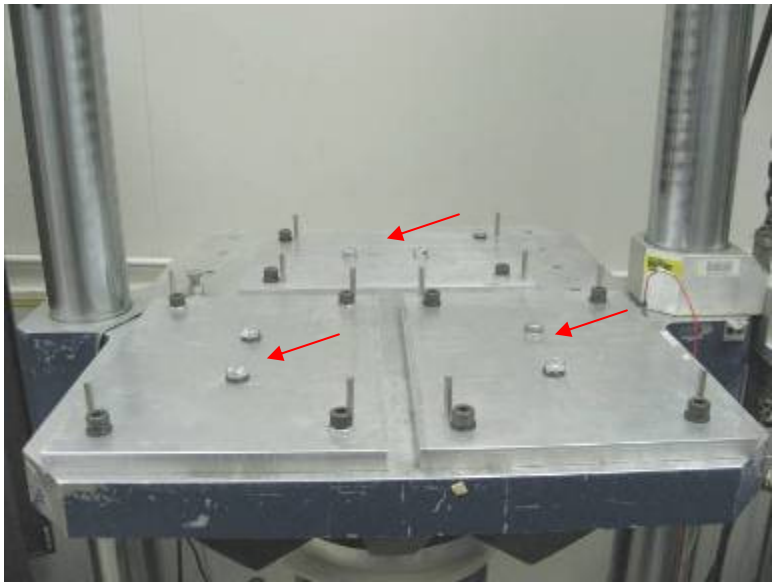
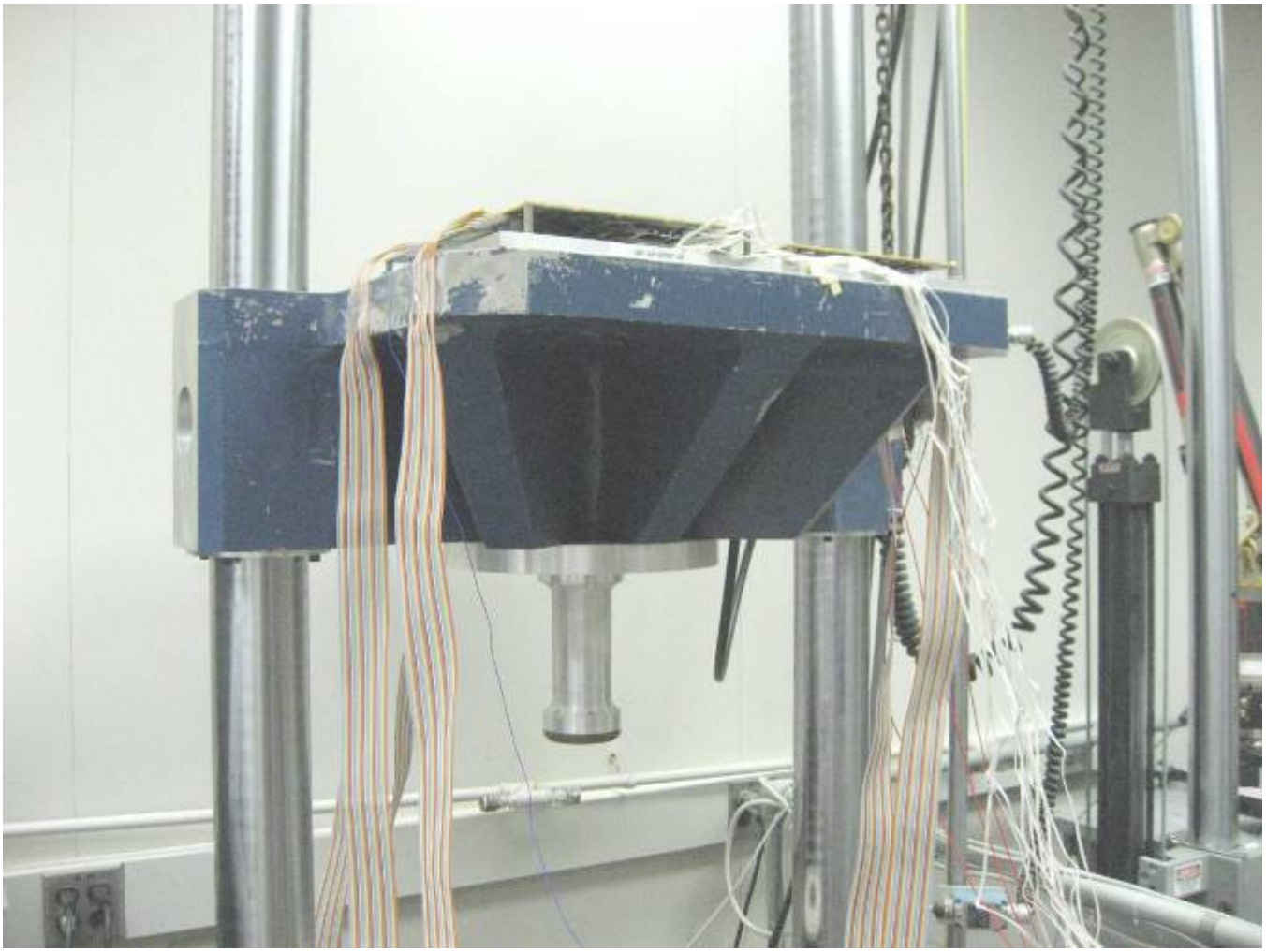


Figure 9.1: Card Fixtures (with center bolts)

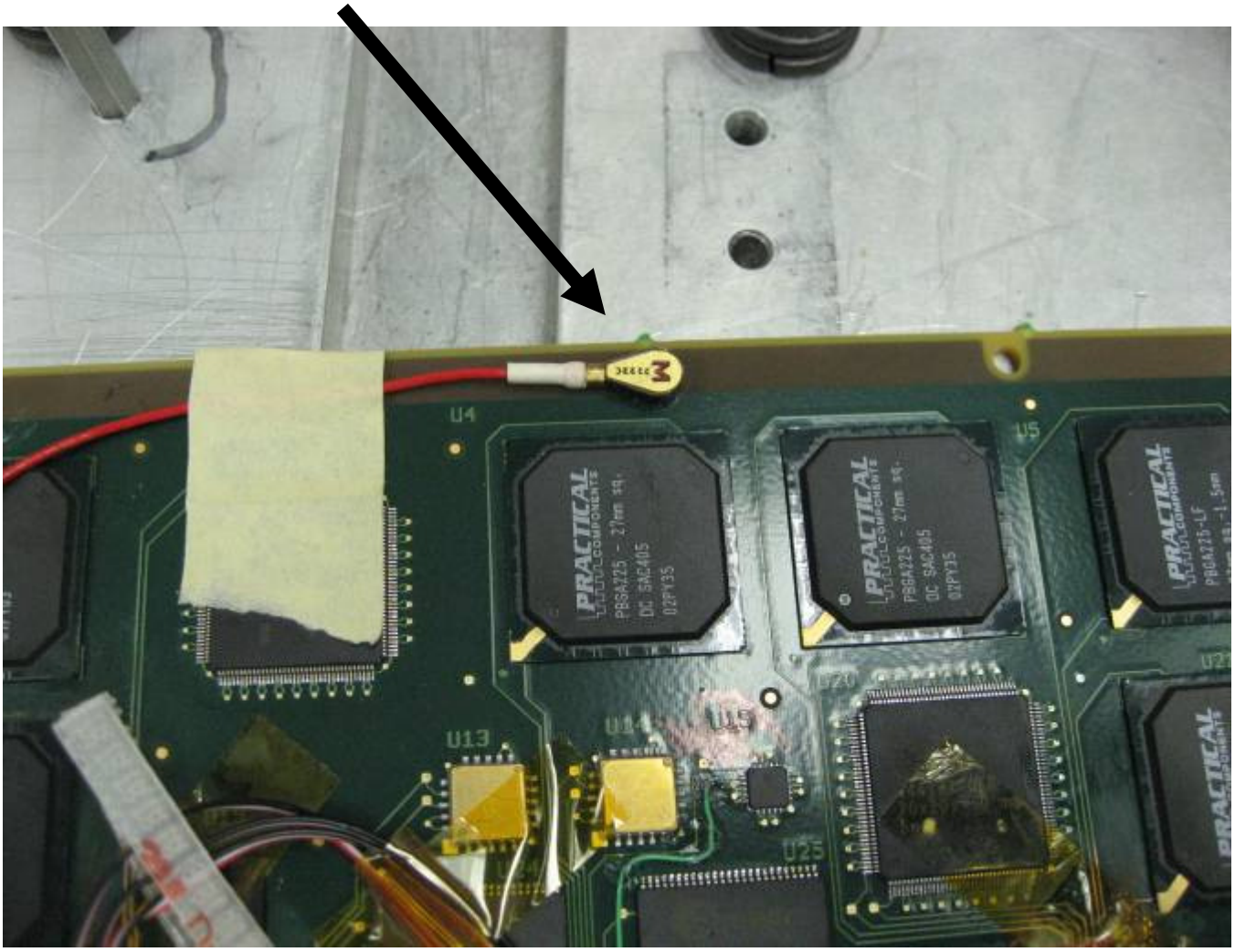
Note: The two center bolts on all three fixtures were removed after drop number 6 on set 1 (cards 144, 159, 185).

Figure 9.2: Card Fixtures (no center bolts)

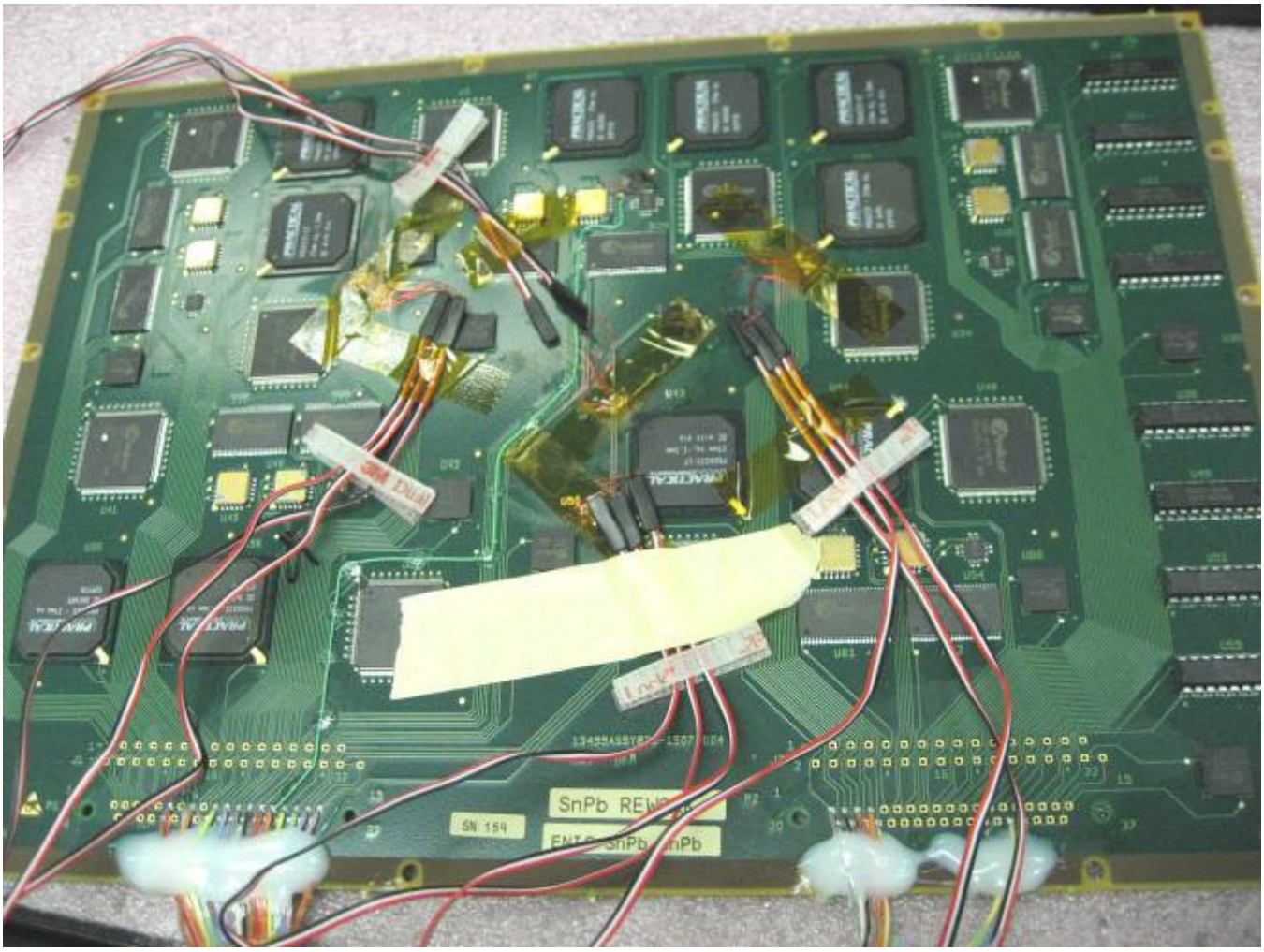
10.2 Shock Table: Drop Height



10.3 Accelerometer Location



10.4 Strain Wired Test Vehicle



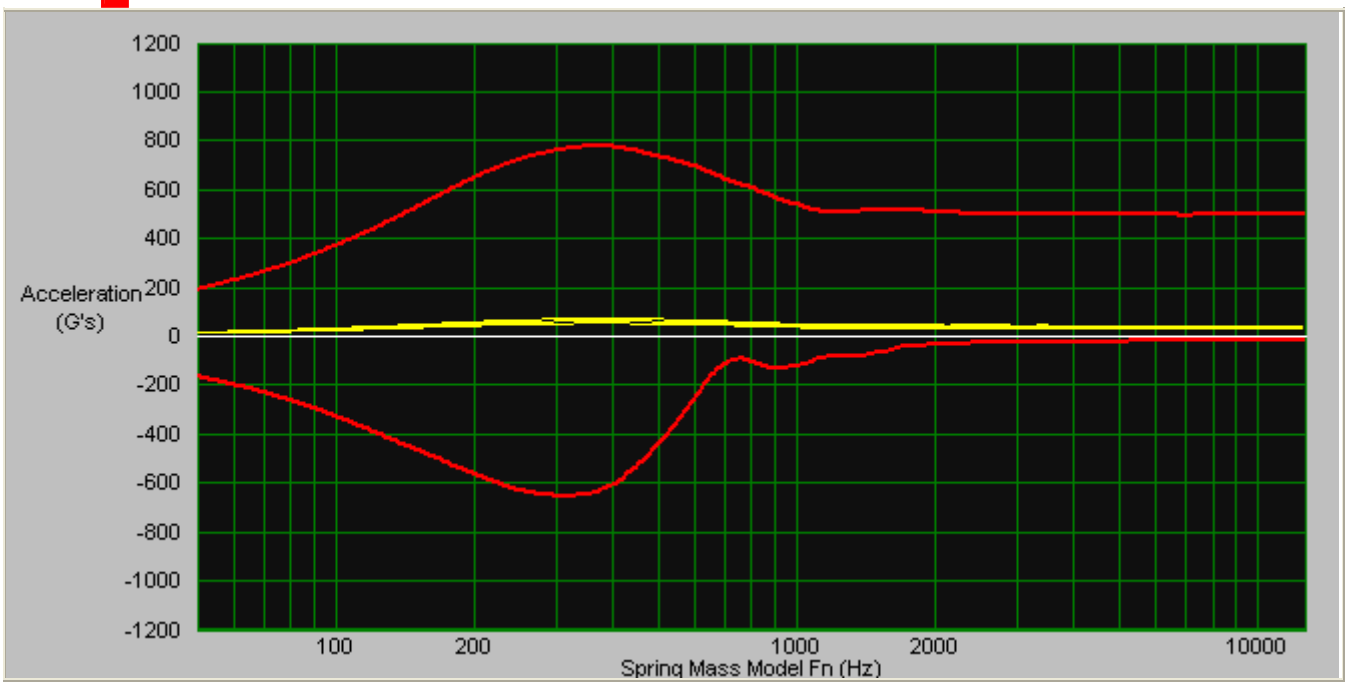
11. APPENDIX B: Drop Testing Graphs

11.1 Set 1 – Card 144, 159, 185

Card 144, 159 (strain gauged), 185 – Drop 1

Shock Response Spectra

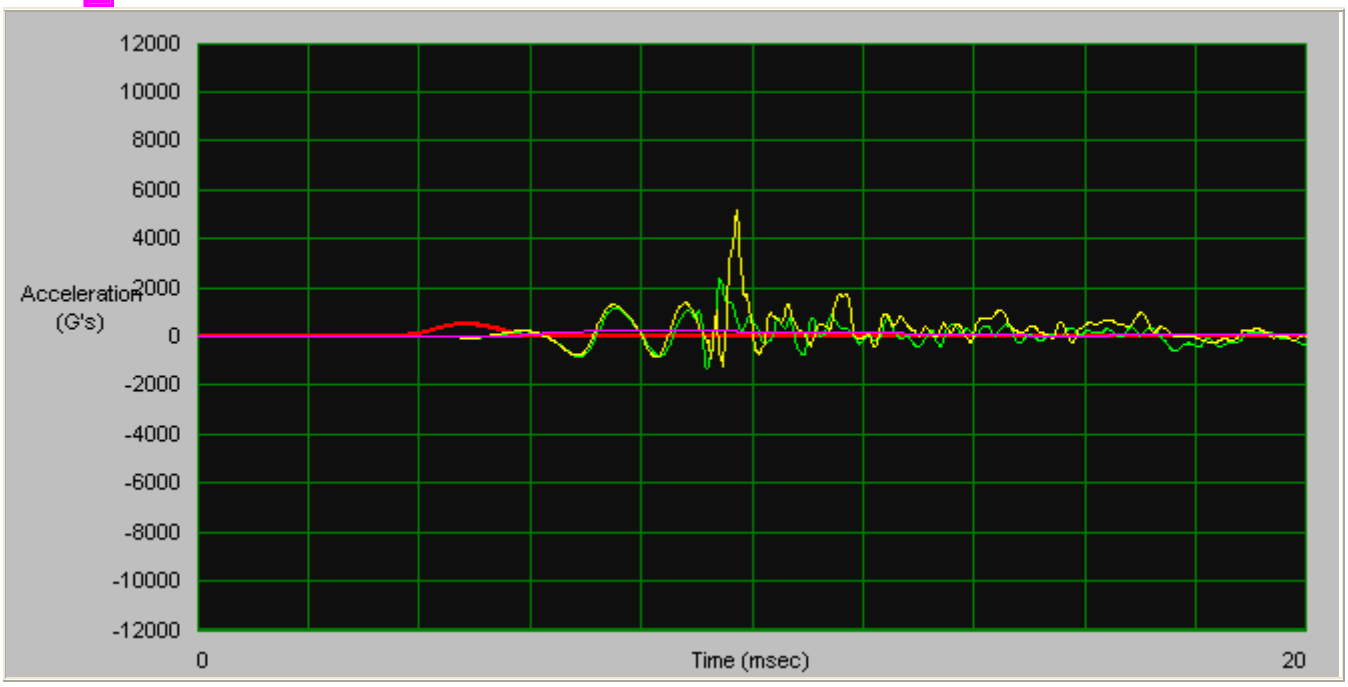
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	777.21	366.80	-652.54	312.93	-	-	-	-



Card 144, 159, 185 – Drop 2

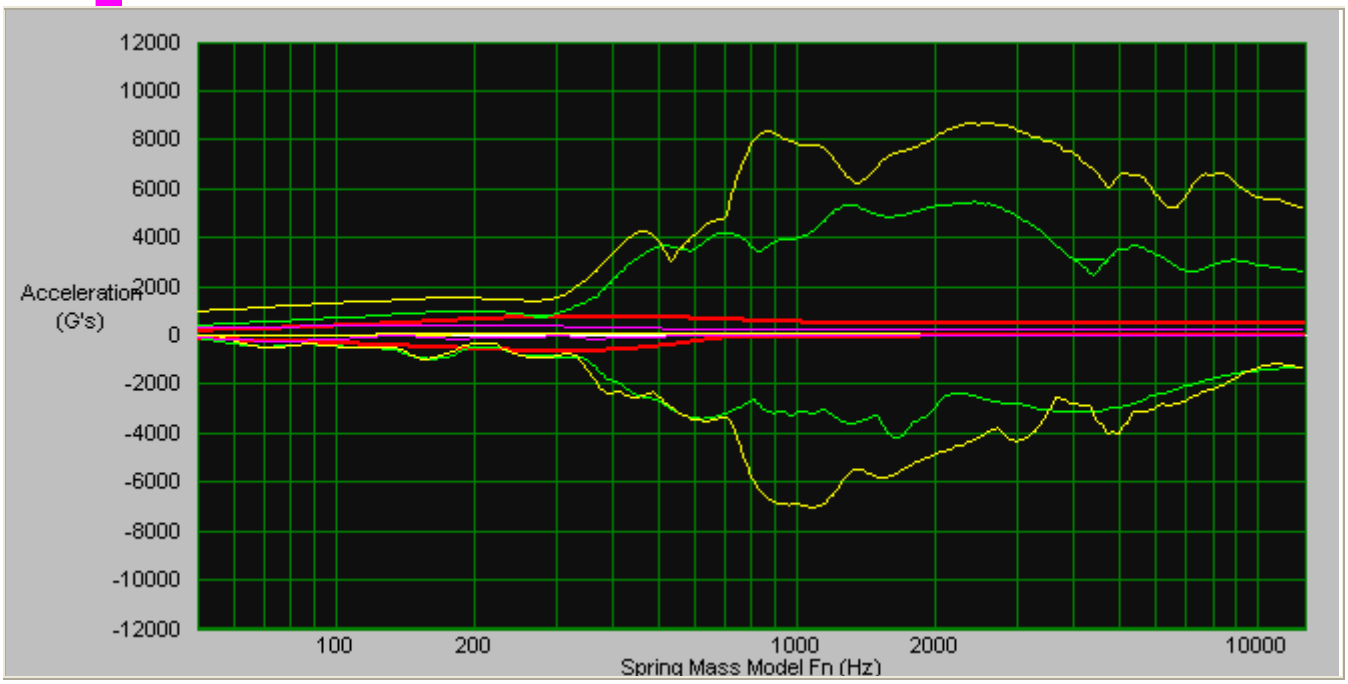
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	494.29	1.98	238.70	1262.63	494.29	-17.91
Ch2	144	2348.19	0.50	305.18	2840.91	2348.19	-1328.16
Ch3	185	5144.89	0.48	484.08	4166.67	5144.89	-1195.52
Ch4	159 (strain gauged)	215.35	9.48	585.85	344.35	215.35	-17.70



Shock Response Spectra

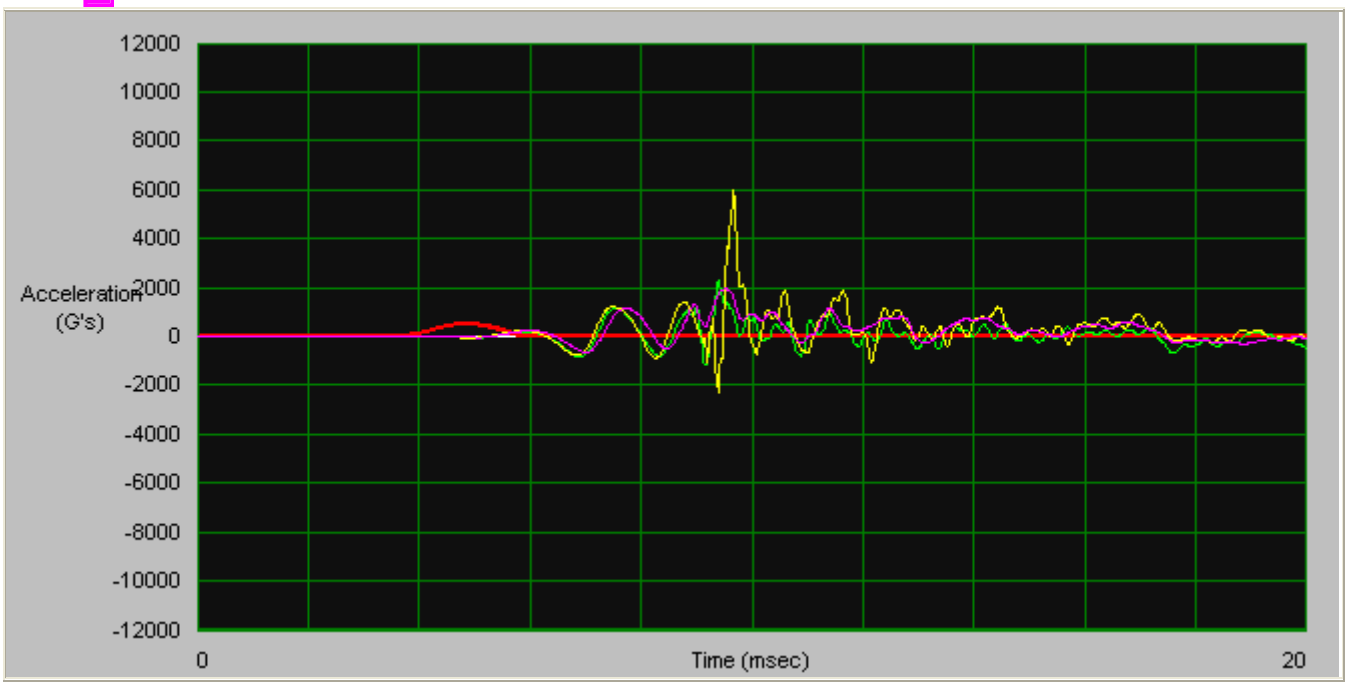
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	772.22	366.80	-647.03	312.93	-	-	-	-
SRS2	Composite	0.05	5449.60	2432.16	-4184.64	1646.88	-	-	-	-
SRS3	Composite	0.05	8678.66	2397.29	-7032.40	1083.40	-	-	-	-
SRS4	Composite	0.05	390.93	145.57	-216.38	76.01	-	-	-	-



Card 144, 159, 185 – Drop 3

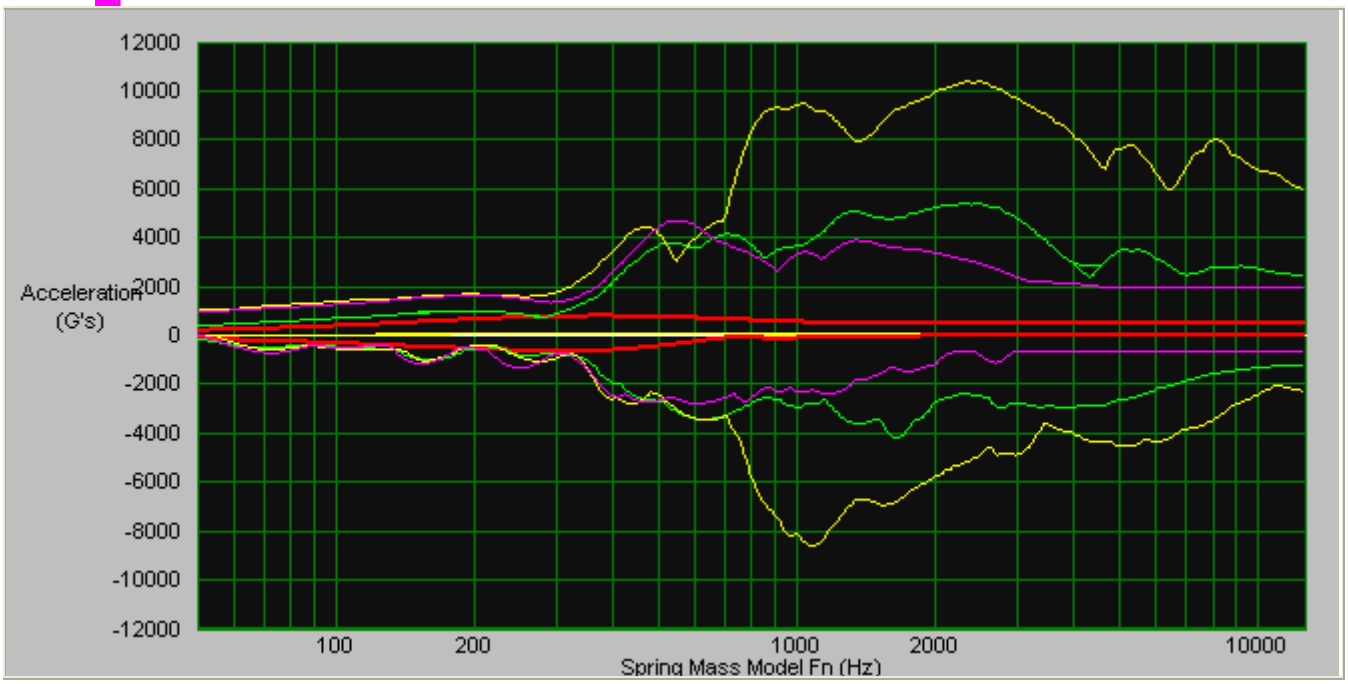
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	497.82	1.98	239.58	1275.51	497.82	-20.23
Ch2	144	2324.25	0.50	233.23	2717.39	2324.25	-1183.71
Ch3	185	5958.23	0.46	535.53	4310.34	5958.23	-2256.57
Ch4	159 (strain gauged)	1935.78	1.98	735.23	1262.63	1935.78	-641.92



Shock Response Spectra

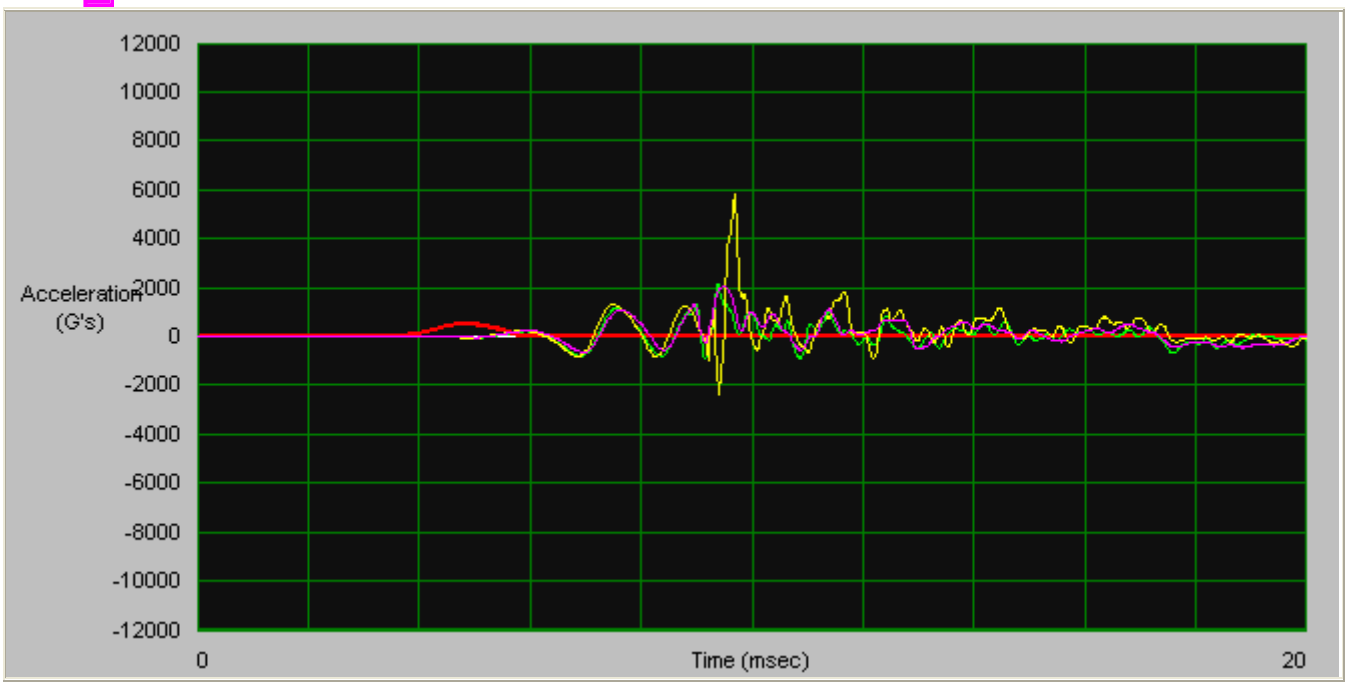
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	780.97	377.55	-652.91	317.48	-	-	-	-
SRS2	Composite	0.05	5388.89	2295.65	-4161.40	1670.84	-	-	-	-
SRS3	Composite	0.05	10380.03	2467.54	-8603.13	1083.40	-	-	-	-
SRS4	Composite	0.05	4706.38	549.58	-2781.40	616.88	-	-	-	-



Card 144, 159, 185 – Drop 4

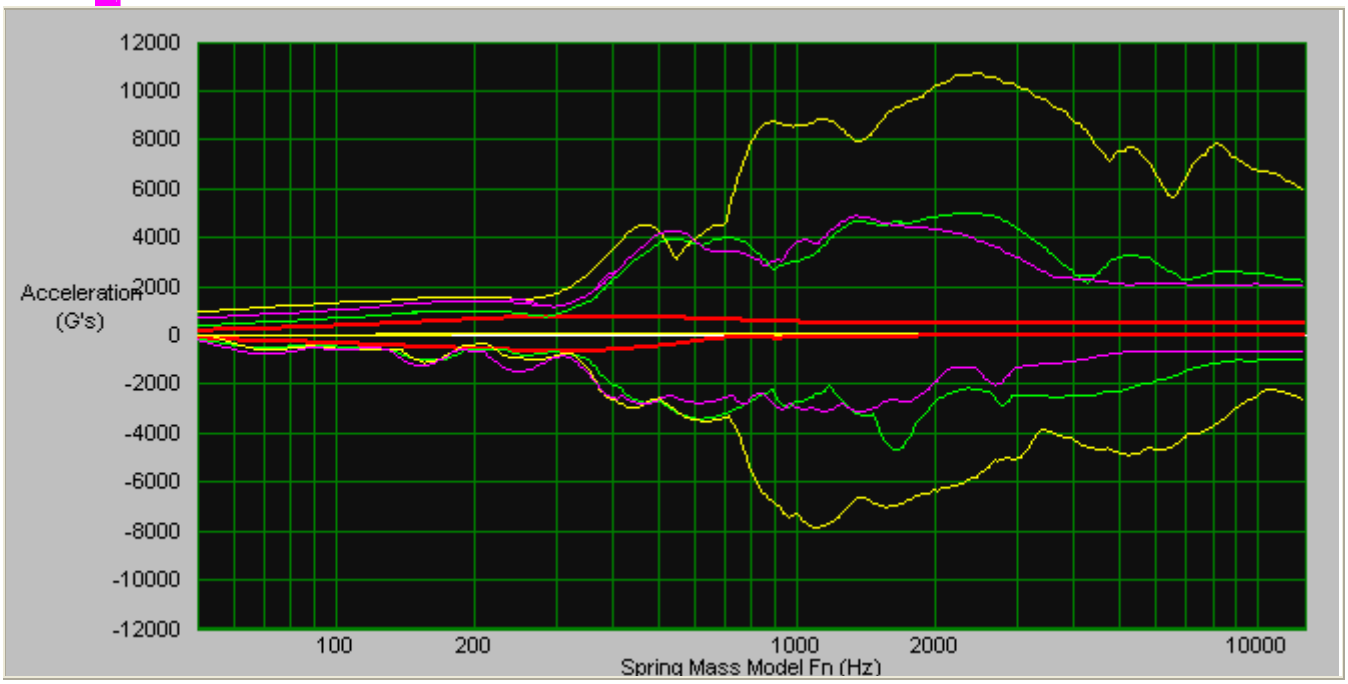
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	491.18	2.00	238.58	1262.63	491.18	-19.37
Ch2	144	2152.09	0.48	309.61	2500.00	2152.09	-935.09
Ch3	185	5835.61	0.46	519.65	4310.34	5835.61	-2389.32
Ch4	159 (strain gauged)	2033.08	1.38	510.17	1712.33	2033.08	-642.91



Shock Response Spectra

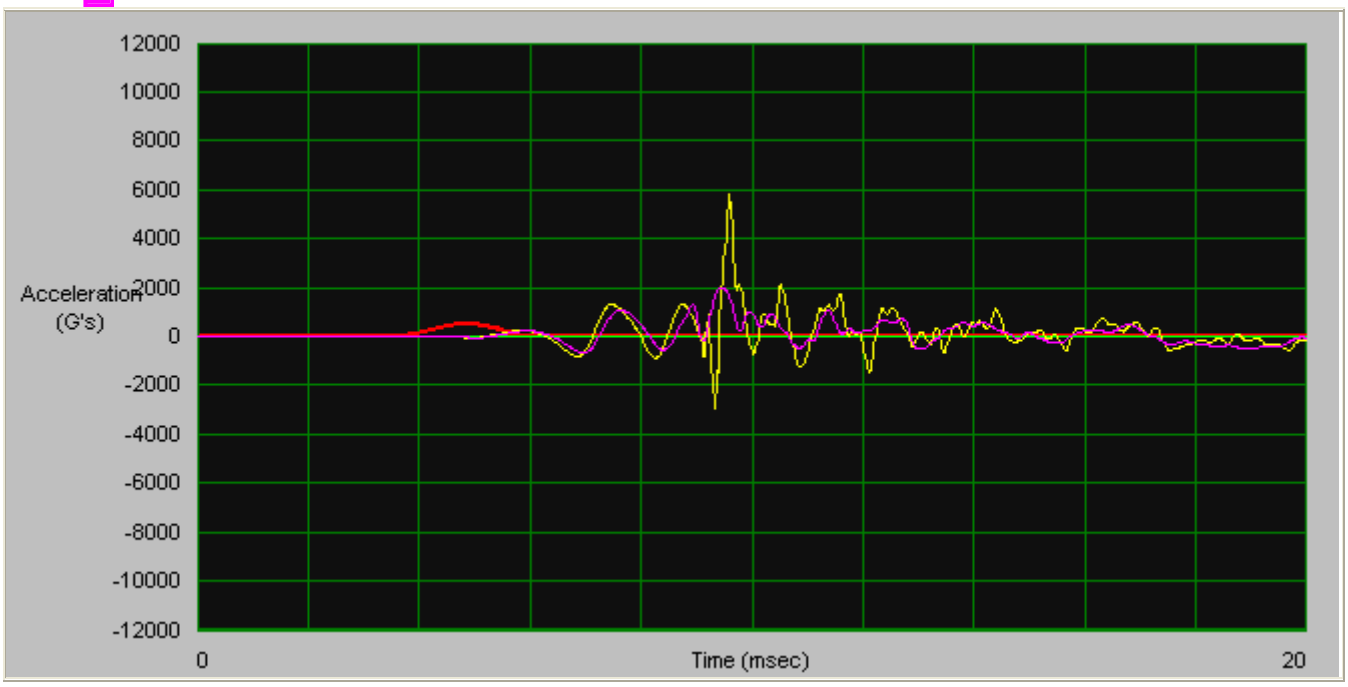
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	767.54	361.54	-646.38	308.44	-	-	-	-
SRS2	Composite	0.05	5018.11	2432.16	-4659.92	1623.27	-	-	-	-
SRS3	Composite	0.05	10715.47	2467.54	-7861.65	1099.16	-	-	-	-
SRS4	Composite	0.05	4882.94	1345.43	-3114.00	1384.86	-	-	-	-



Card 144, 159, 185 – Drop 5

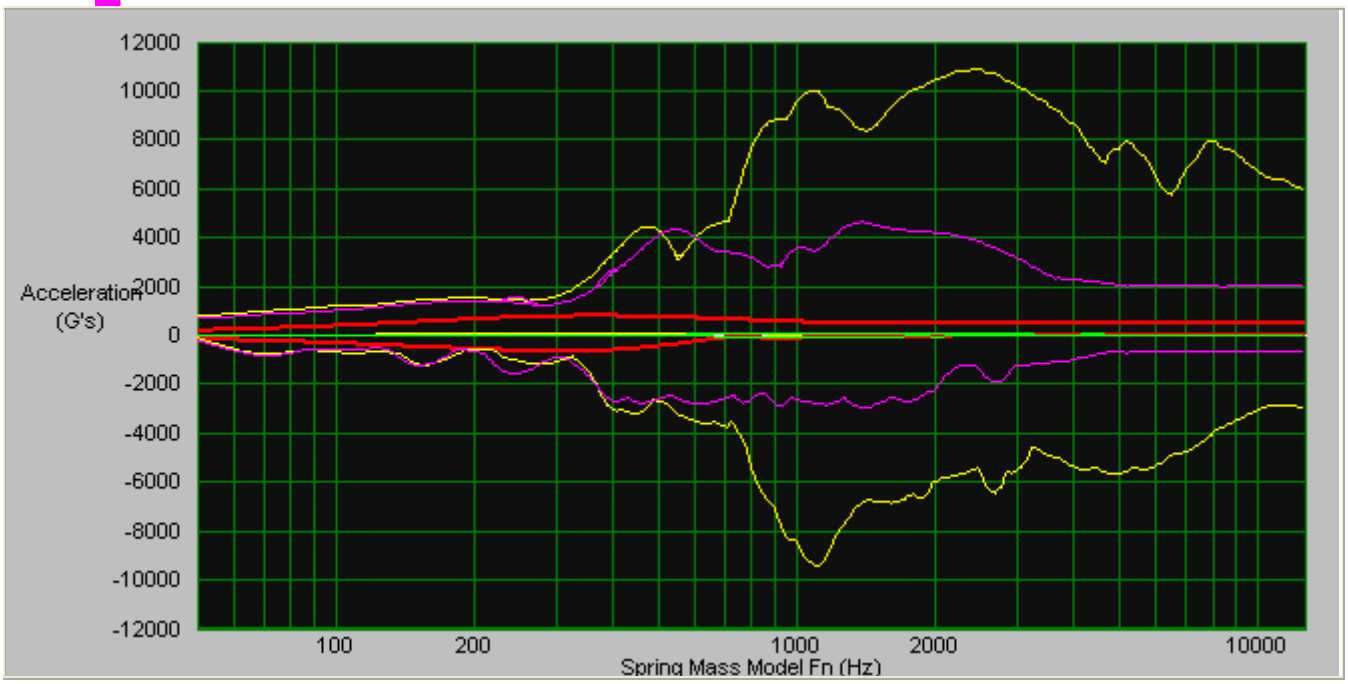
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	500.49	1.96	240.32	1275.51	500.49	-25.10
Ch2	144	34.38	0.54	4.73	4464.29	34.38	-24.11
Ch3	185	5852.86	0.48	513.66	4464.29	5852.86	-2922.35
Ch4	159 (strain gauged)	1982.30	1.42	508.76	1689.19	1982.30	-665.84



Shock Response Spectra

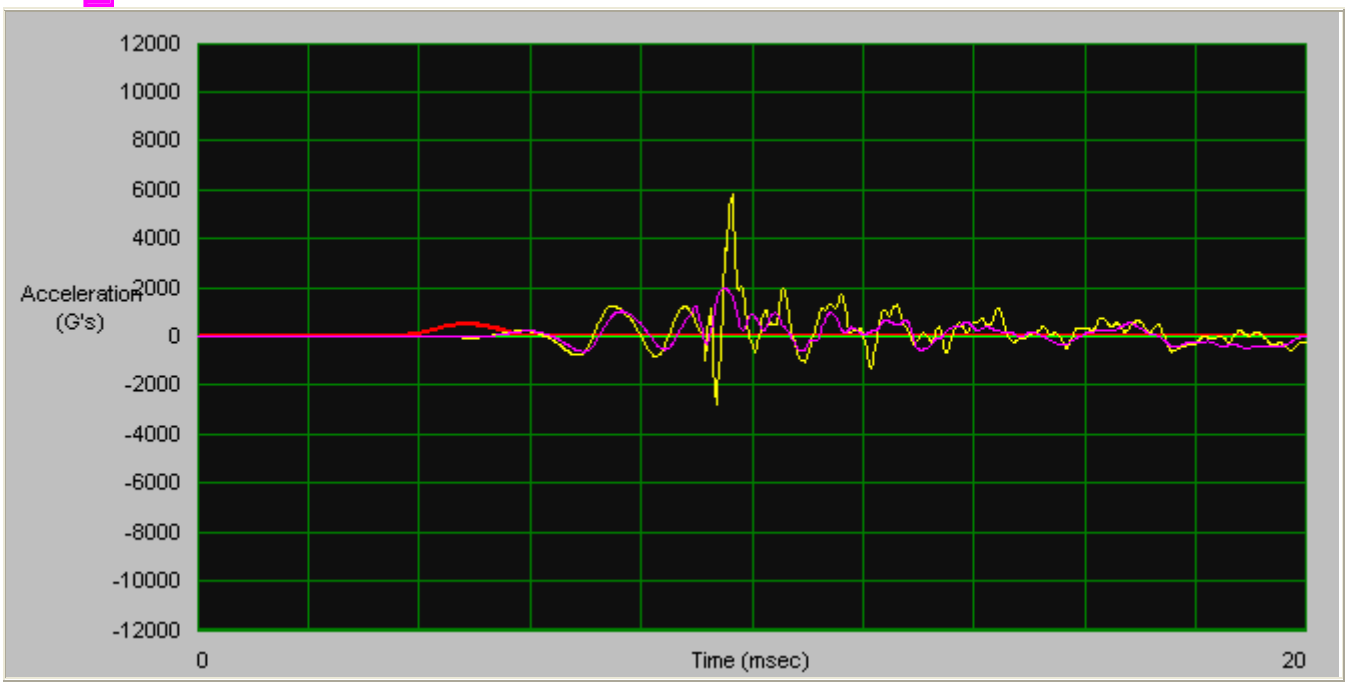
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	783.37	361.54	-664.53	312.93	-	-	-	-
SRS2	Composite	0.05	117.57	859.90	-106.28	1164.52	-	-	-	-
SRS3	Composite	0.05	10909.38	2432.16	-9392.27	1099.16	-	-	-	-
SRS4	Composite	0.05	4629.72	1384.86	-2953.79	1405.00	-	-	-	-



Card 144, 159, 185 – Drop 6

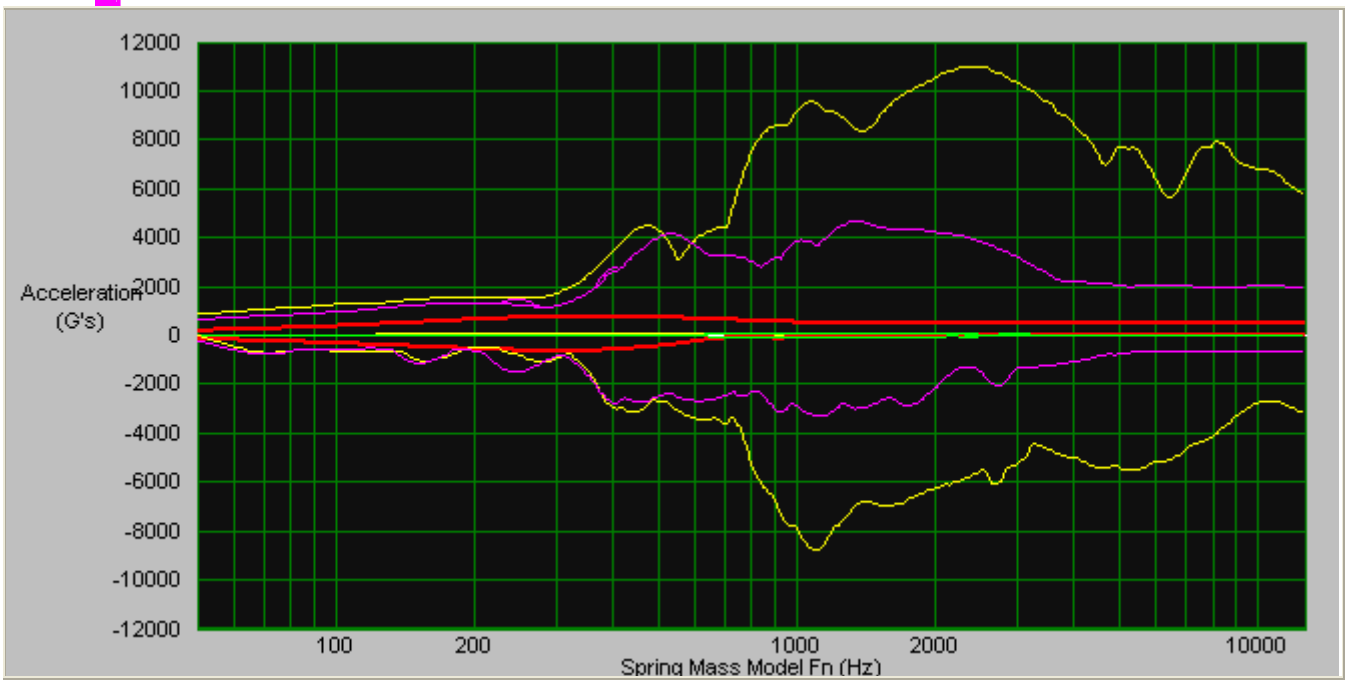
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	489.84	1.98	237.04	1262.63	489.84	-25.64
Ch2	144	31.27	0.58	4.34	3472.22	31.27	-25.66
Ch3	185	5778.28	0.48	523.31	4310.34	5778.28	-2784.59
Ch4	159 (strain gauged)	1966.68	1.42	494.31	1689.19	1966.68	-619.85



Shock Response Spectra

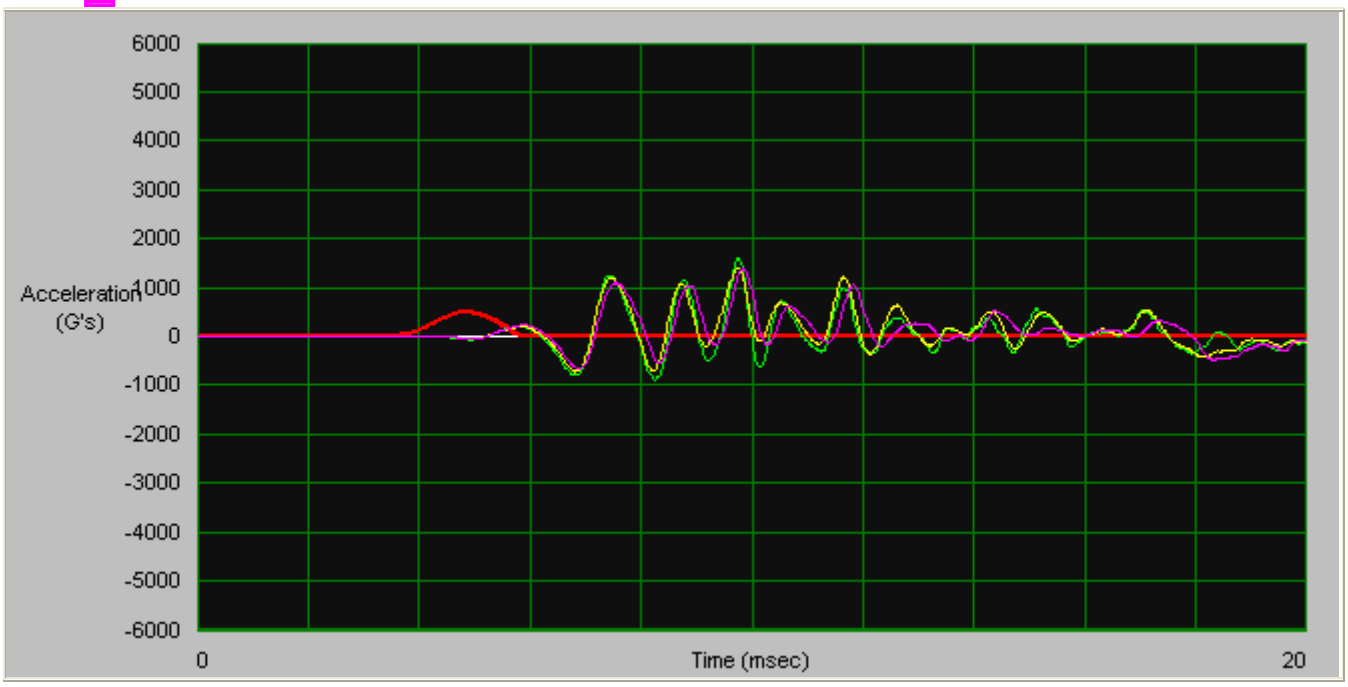
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	763.95	361.54	-642.68	308.44	-	-	-	-
SRS2	Composite	0.05	102.86	1233.77	-90.56	1216.08	-	-	-	-
SRS3	Composite	0.05	11002.32	2362.92	-8756.47	1099.16	-	-	-	-
SRS4	Composite	0.05	4663.17	1345.43	-3296.27	1115.15	-	-	-	-



Card 144, 159, 185 – Drop 7

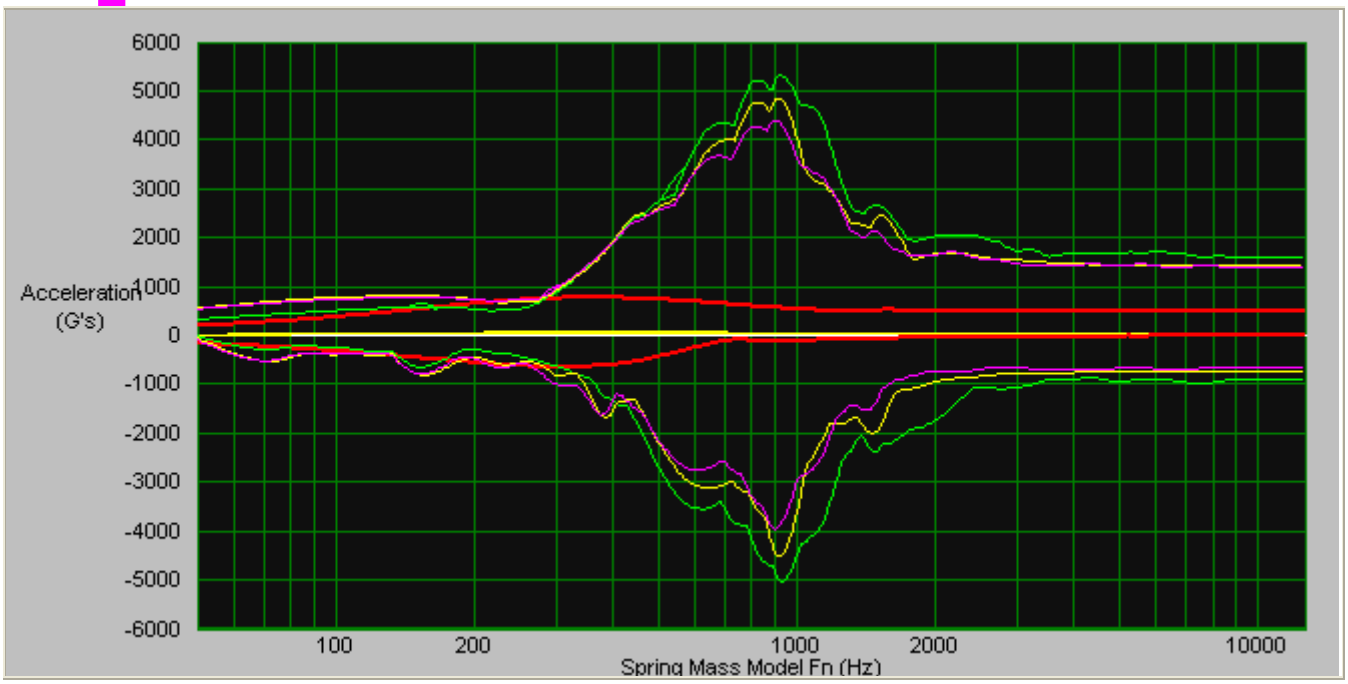
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	492.24	1.98	238.45	1262.63	492.24	-17.42
Ch2	144	1593.34	0.52	196.75	4464.29	1593.34	-885.83
Ch3	185	1409.58	0.70	226.35	3205.13	1409.58	-719.57
Ch4	159 (strain gauged)	1377.81	0.66	215.52	3472.22	1377.81	-660.67



Shock Response Spectra

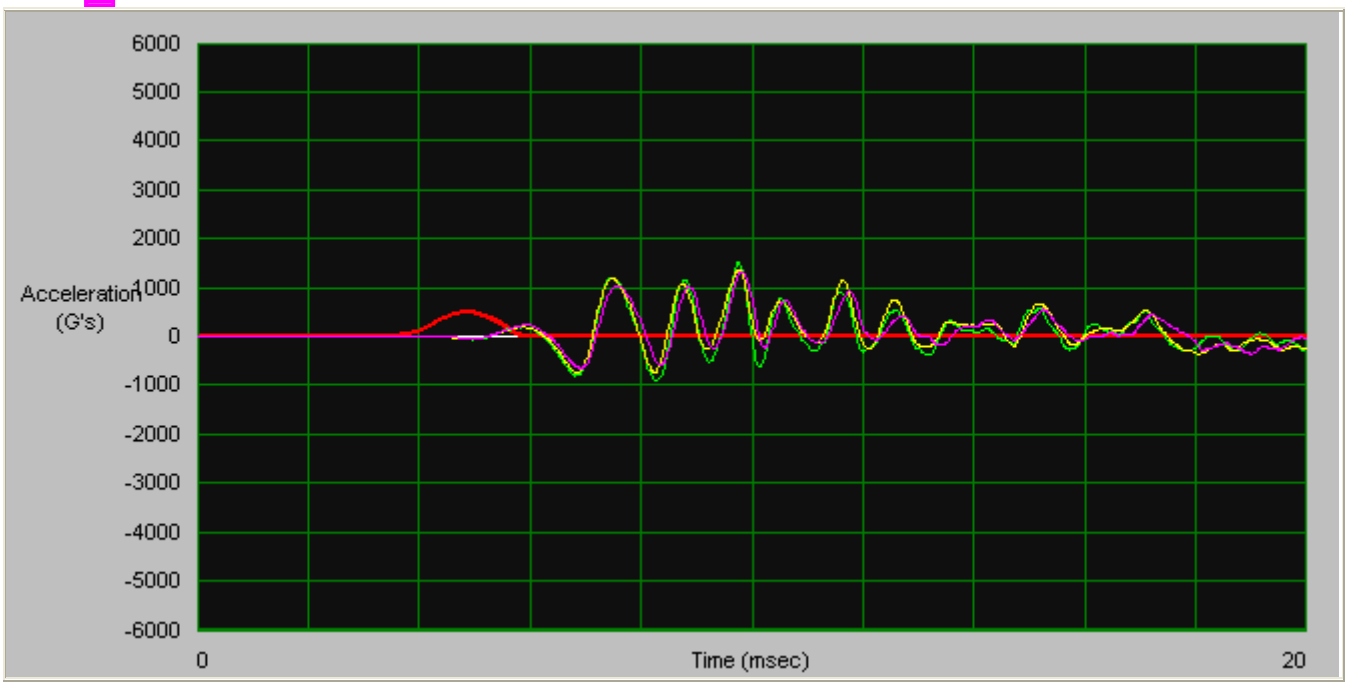
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	767.41	361.54	-648.22	312.93	-	-	-	-
SRS2	Composite	0.05	5307.71	924.28	-5026.74	937.73	-	-	-	-
SRS3	Composite	0.05	4852.22	911.03	-4523.93	911.03	-	-	-	-
SRS4	Composite	0.05	4396.45	897.97	-3961.45	897.97	-	-	-	-



Card 144, 159, 185 – Drop 8

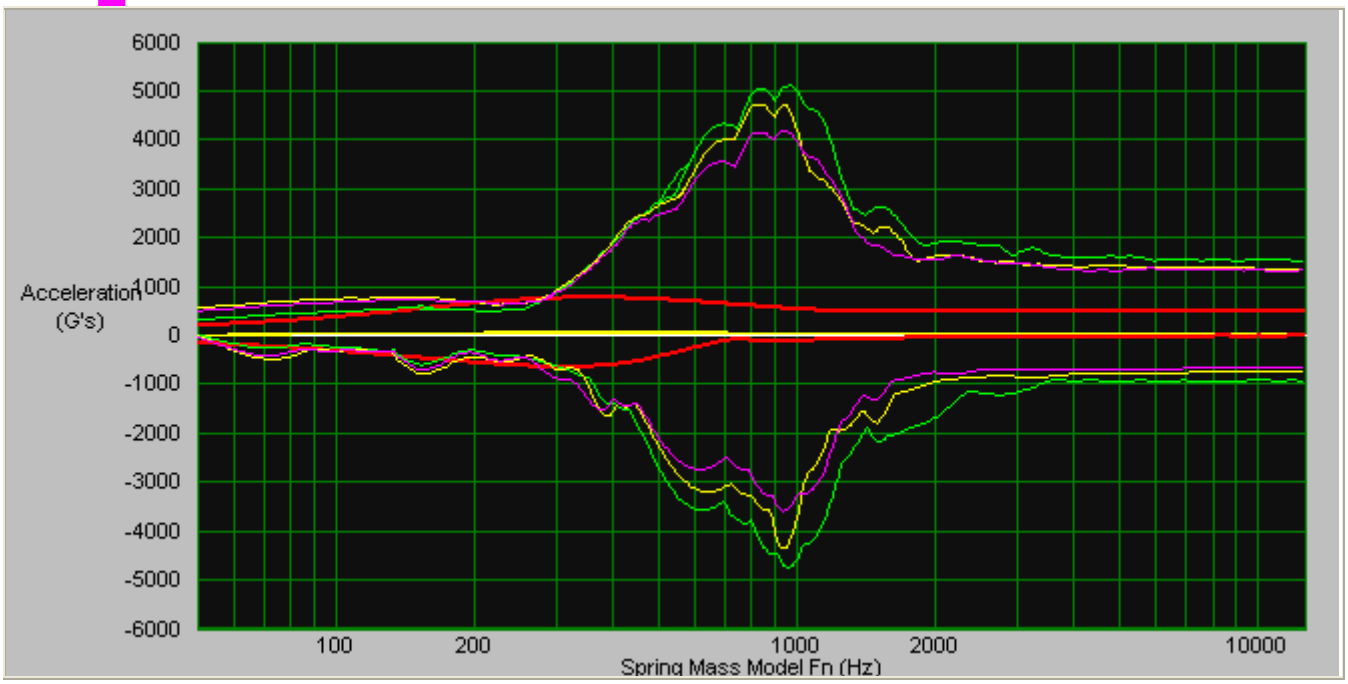
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	492.19	1.98	238.91	1262.63	492.19	-20.08
Ch2	144	1515.74	0.52	185.87	4464.29	1515.74	-907.04
Ch3	185	1363.78	0.68	214.18	3289.47	1363.78	-739.18
Ch4	159 (strain gauged)	1323.71	0.64	205.03	3571.43	1323.71	-655.48



Shock Response Spectra

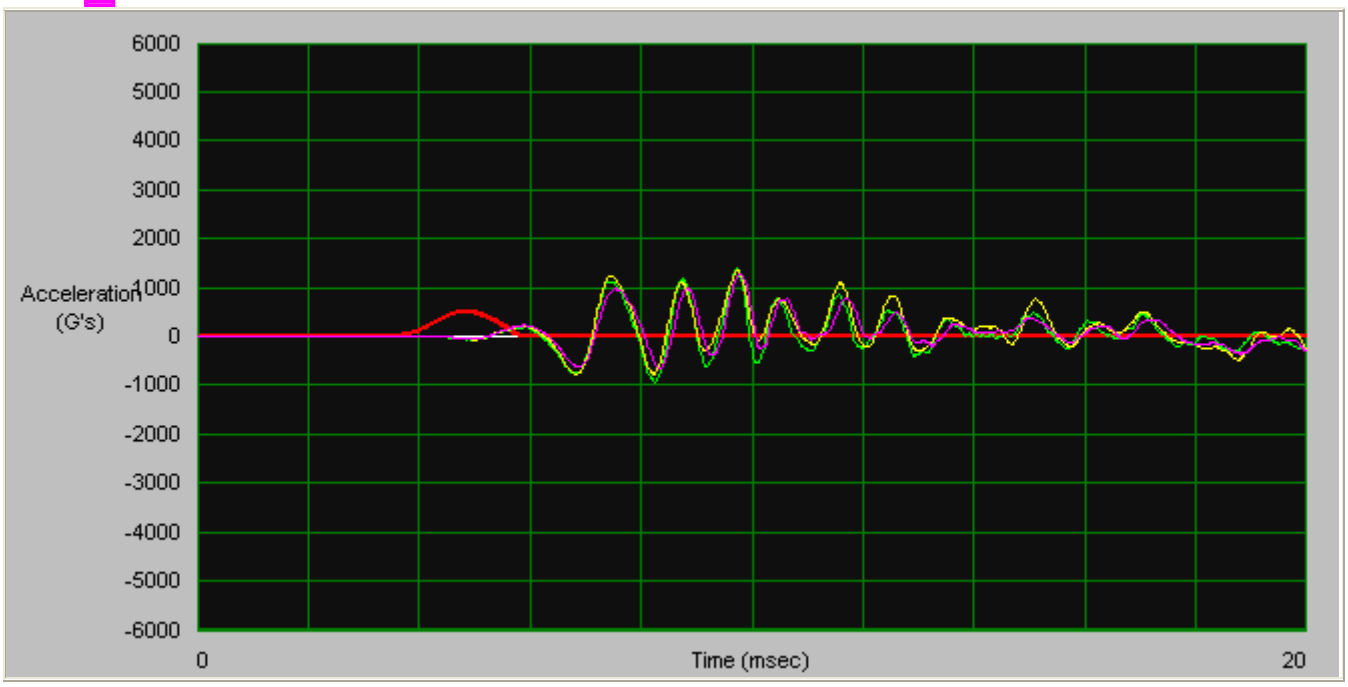
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	768.32	361.54	-648.40	308.44	-	-	-	-
SRS2	Composite	0.05	5099.72	965.20	-4757.24	965.20	-	-	-	-
SRS3	Composite	0.05	4723.15	937.73	-4357.99	937.73	-	-	-	-
SRS4	Composite	0.05	4184.37	937.73	-3584.92	937.73	-	-	-	-



Card 144, 159, 185 – Drop 9

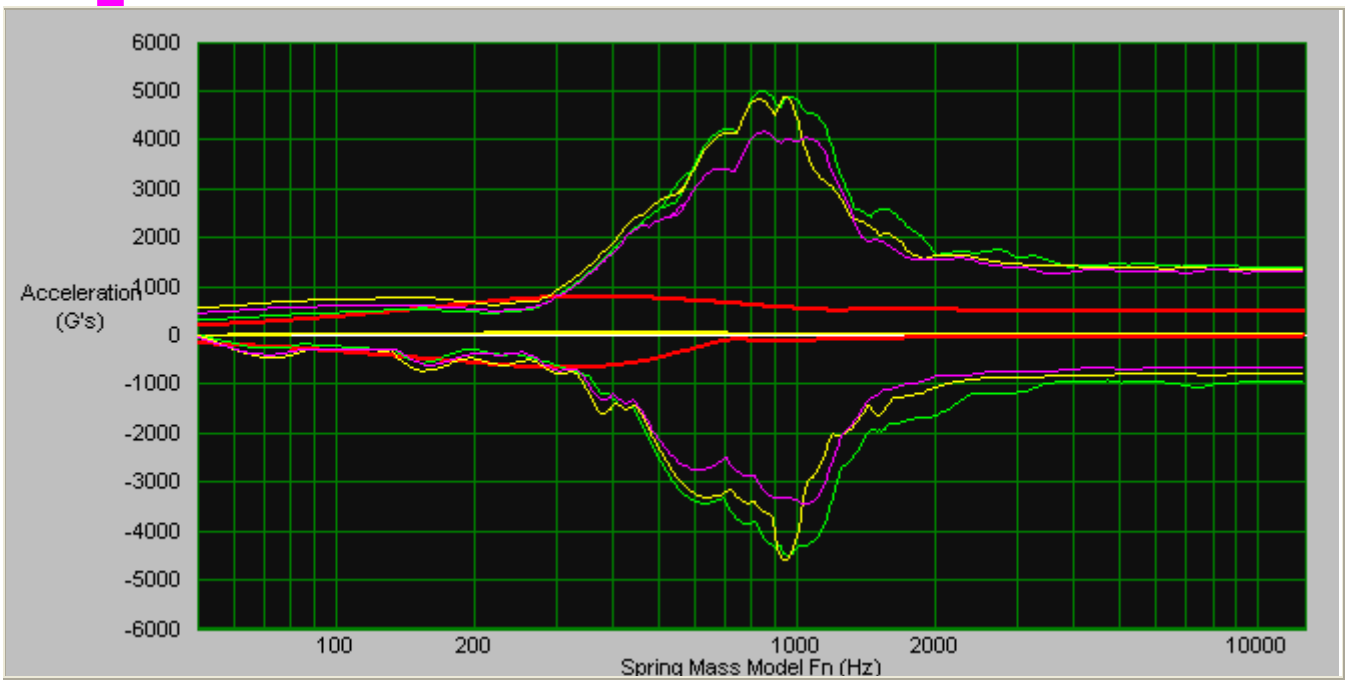
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	500.74	1.96	240.52	1288.66	500.74	-20.16
Ch2	144	1384.63	0.54	173.36	4464.29	1384.63	-930.25
Ch3	185	1345.54	0.66	208.45	3378.38	1345.54	-772.69
Ch4	159 (strain gauged)	1272.63	0.58	184.02	4032.26	1272.63	-654.63



Shock Response Spectra

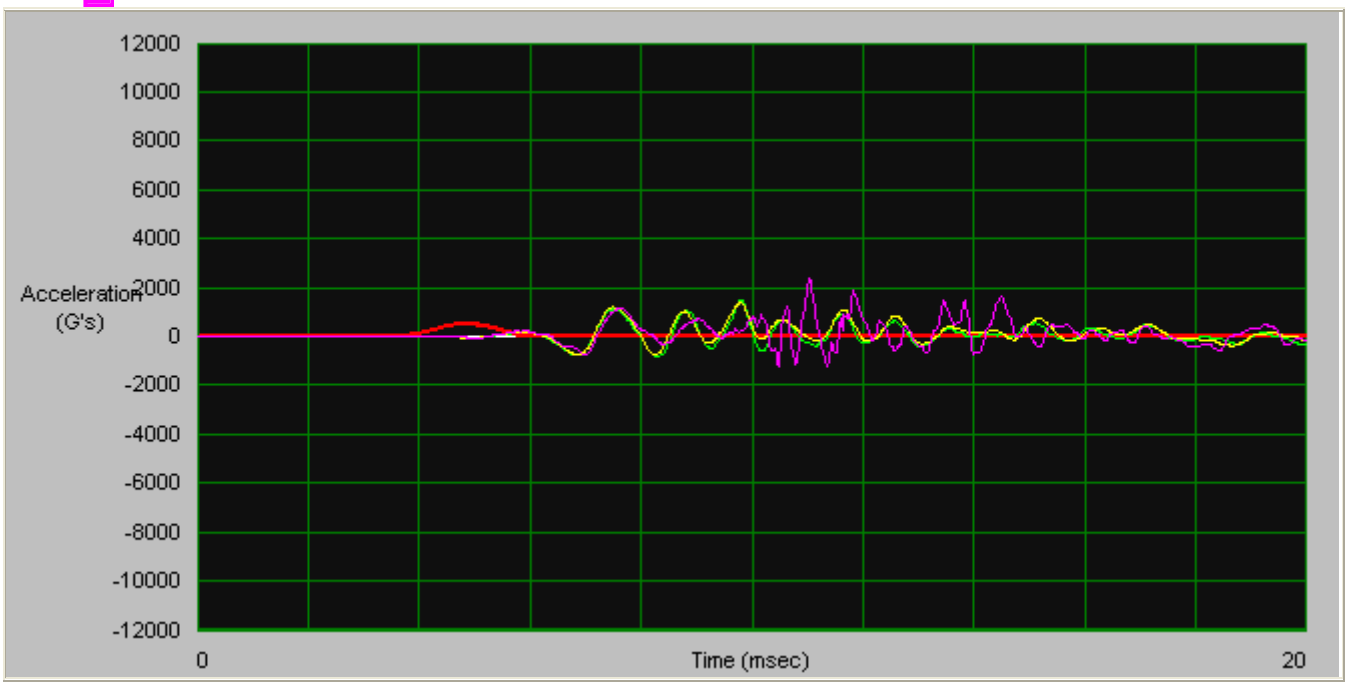
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	788.17	361.54	-667.57	317.48	-	-	-	-
SRS2	Composite	0.05	4989.63	835.42	-4518.64	951.37	-	-	-	-
SRS3	Composite	0.05	4875.52	951.37	-4603.52	951.37	-	-	-	-
SRS4	Composite	0.05	4157.64	847.57	-3438.85	1052.56	-	-	-	-



Card 144, 159, 185 – Drop 10

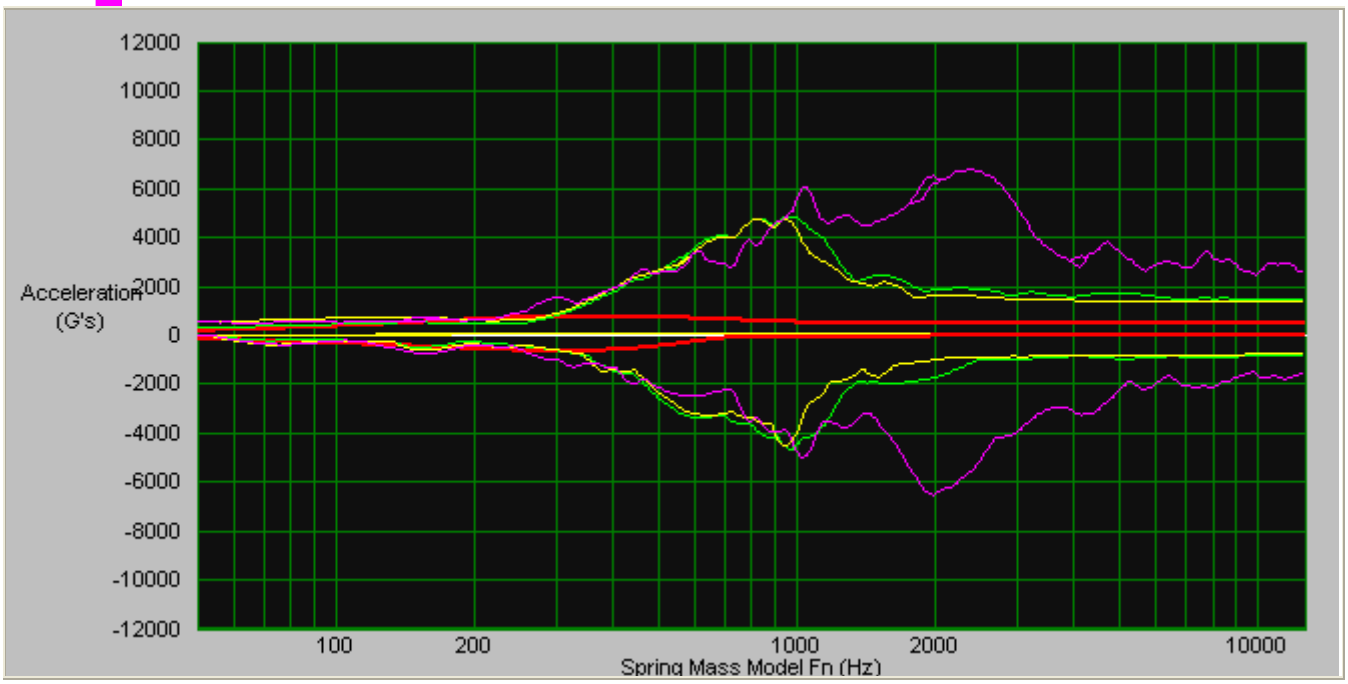
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	491.51	1.98	235.42	1262.63	491.51	-19.37
Ch2	144	1468.85	0.52	177.29	4464.29	1468.85	-828.78
Ch3	185	1357.40	0.64	203.27	3472.22	1357.40	-764.71
Ch4	159 (strain gauged)	2363.59	0.32	162.34	5952.38	2363.59	-1245.43



Shock Response Spectra

	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	769.90	366.80	-647.01	312.93	-	-	-	-
SRS2	Composite	0.05	4873.37	965.20	-4666.84	965.20	-	-	-	-
SRS3	Composite	0.05	4761.29	937.73	-4483.64	937.73	-	-	-	-
SRS4	Composite	0.05	6771.01	2362.92	-6514.02	1986.97	-	-	-	-

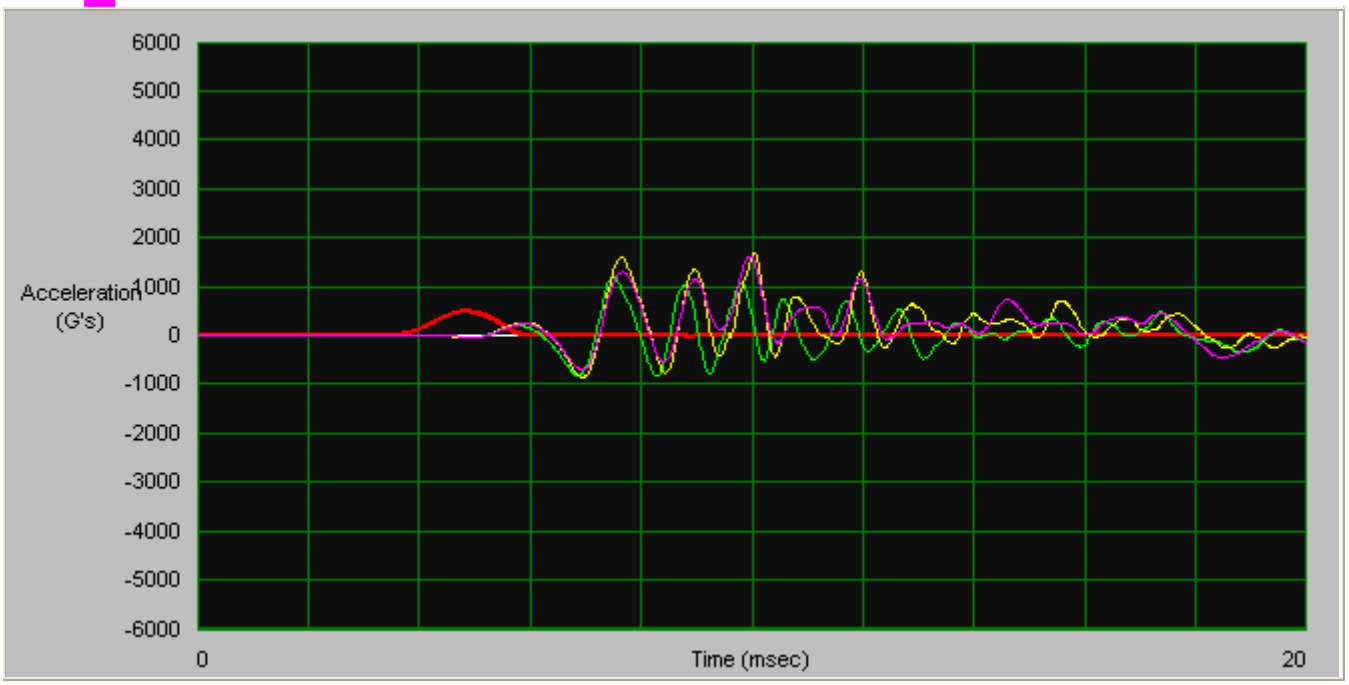


11.2 Set 2 - Card 26, 146, 187 (strain gauged)

Card 26, 146, 187 – Drop 1

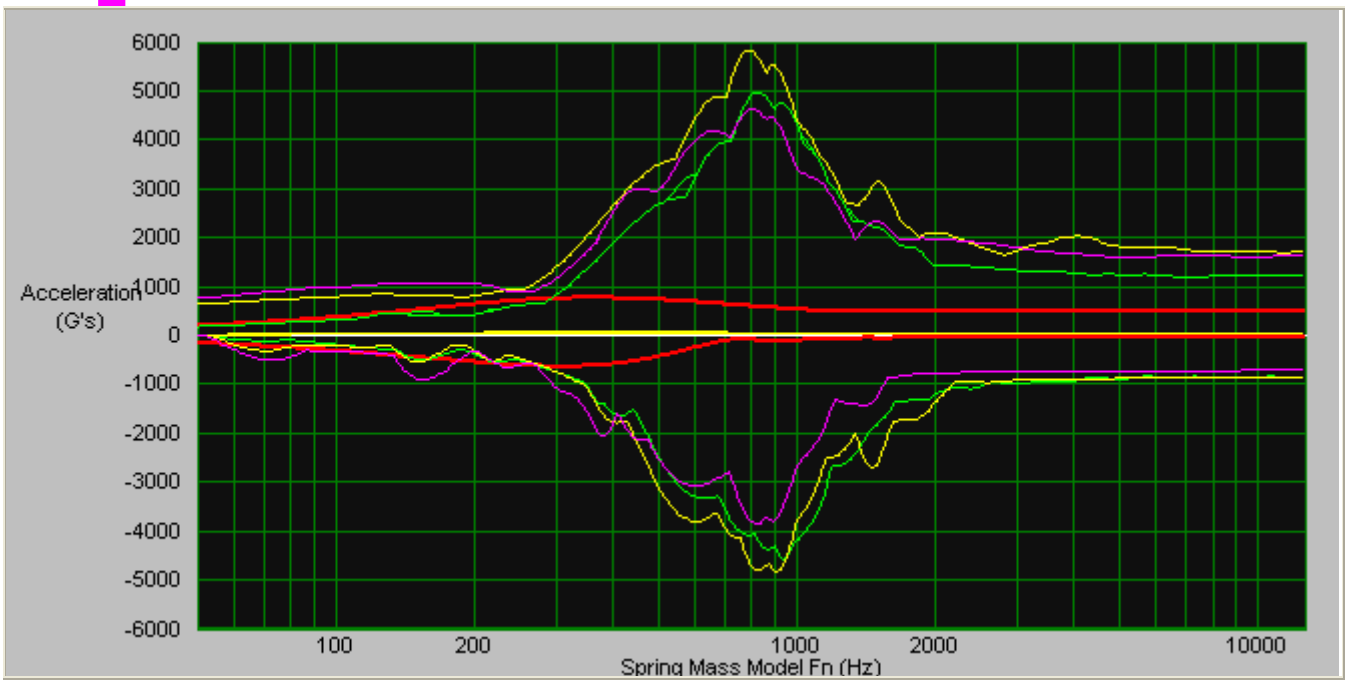
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	485.19	1.96	234.20	1262.63	485.19	-21.57
Ch2	26	1186.22	0.76	220.71	3205.13	1186.22	-838.24
Ch3	146	1689.56	0.64	253.10	2840.91	1689.56	-857.56
Ch4	187 (strain gauged)	1608.69	0.86	507.81	1488.10	1608.69	-711.05



Shock Response Spectra

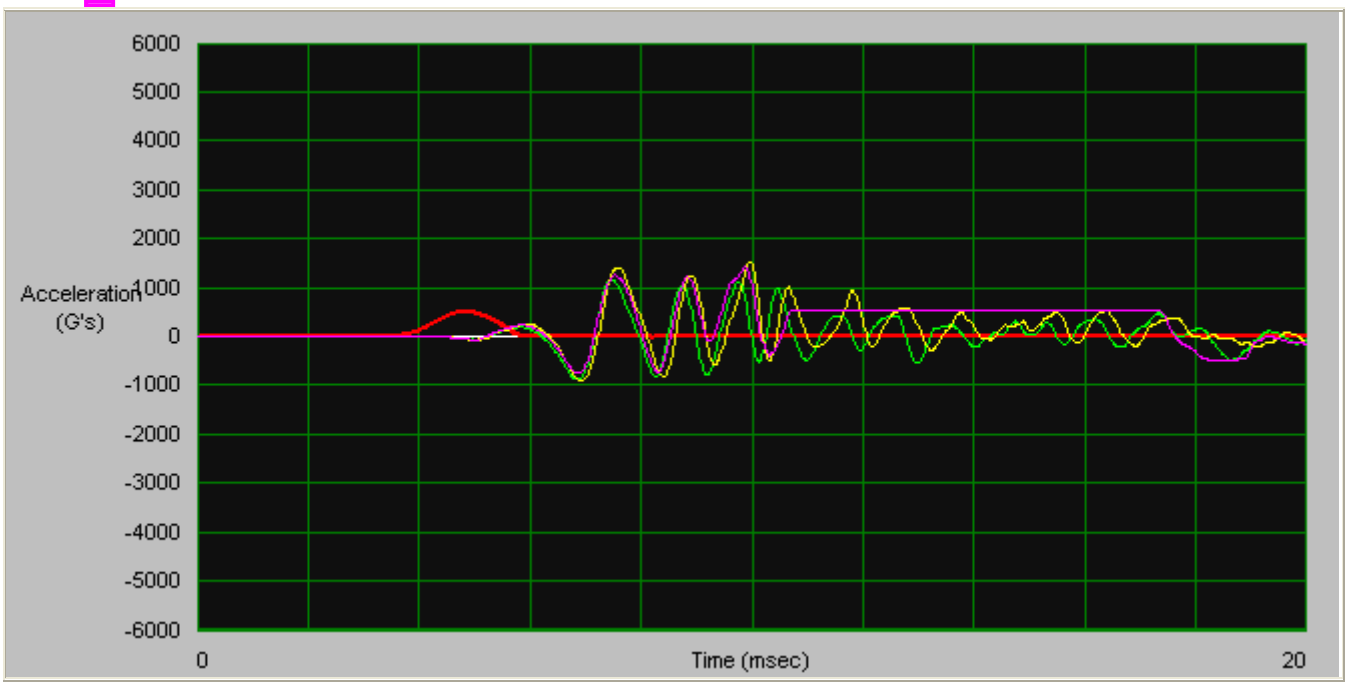
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	762.73	361.54	-639.25	308.44	-	-	-	-
SRS2	Composite	0.05	4969.81	823.44	-4579.65	937.73	-	-	-	-
SRS3	Composite	0.05	5833.16	788.53	-4849.22	897.97	-	-	-	-
SRS4	Composite	0.05	4635.19	800.00	-3855.19	823.44	-	-	-	-



Card 26, 146, 187 – Drop 2

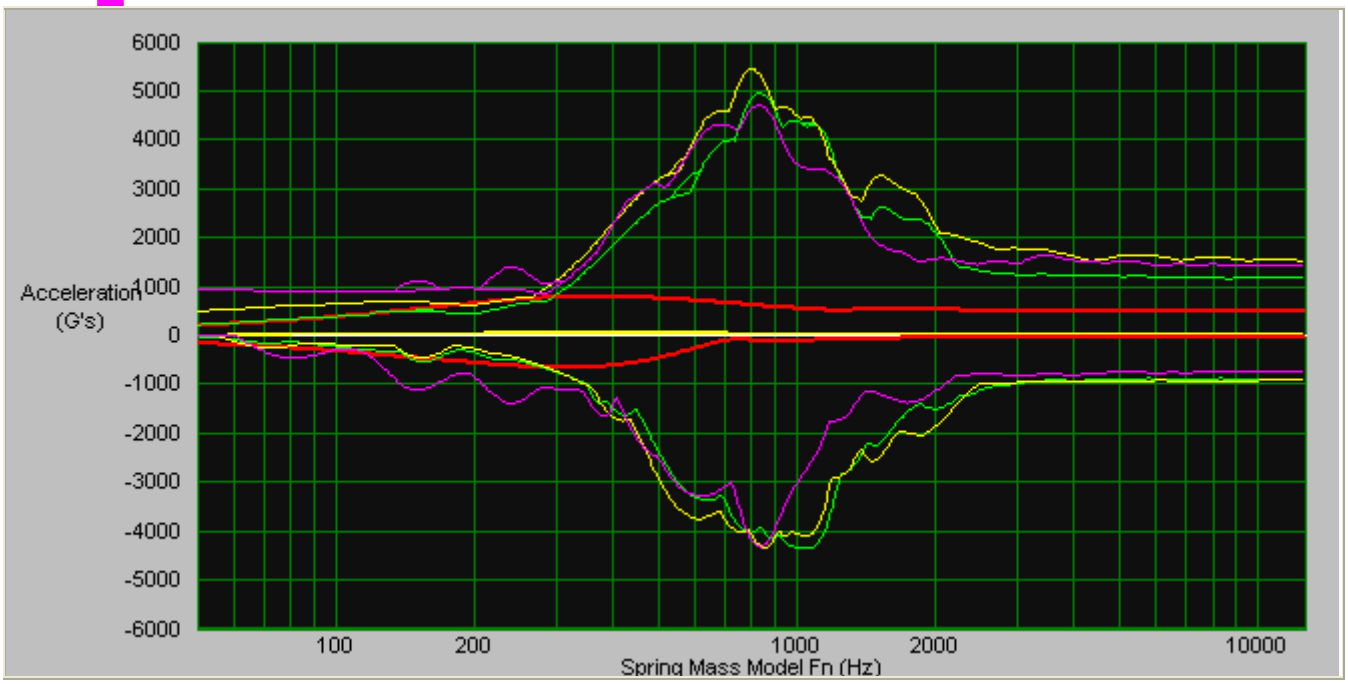
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	500.23	1.94	238.81	1288.66	500.23	-20.54
Ch2	26	1167.42	0.76	217.36	3205.13	1167.42	-879.43
Ch3	146	1529.40	0.66	218.70	2906.98	1529.40	-909.15
Ch4	187 (strain gauged)	1418.55	0.80	282.38	2906.98	1418.55	-744.34



Shock Response Spectra

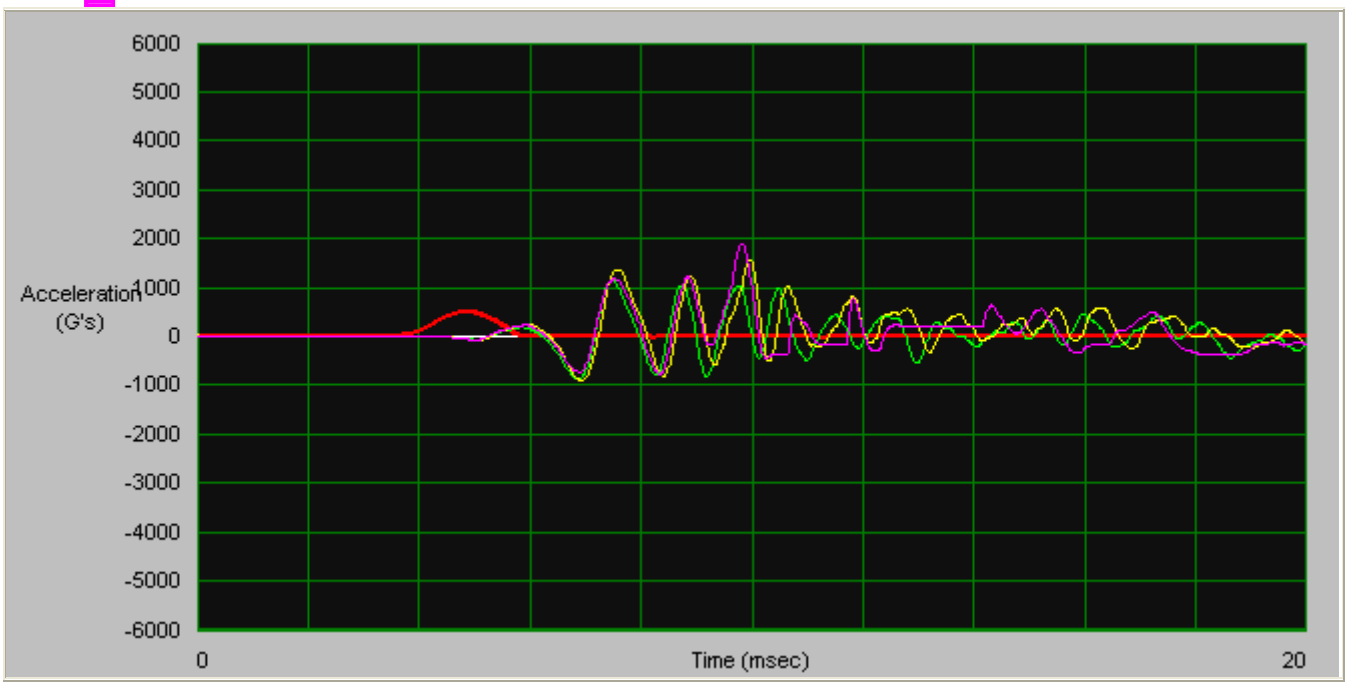
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	787.80	372.14	-663.85	317.48	-	-	-	-
SRS2	Composite	0.05	4946.82	835.42	-4353.56	1052.56	-	-	-	-
SRS3	Composite	0.05	5452.89	800.00	-4329.78	847.57	-	-	-	-
SRS4	Composite	0.05	4705.24	835.42	-4324.28	835.42	-	-	-	-



Card 26, 146, 187 – Drop 3

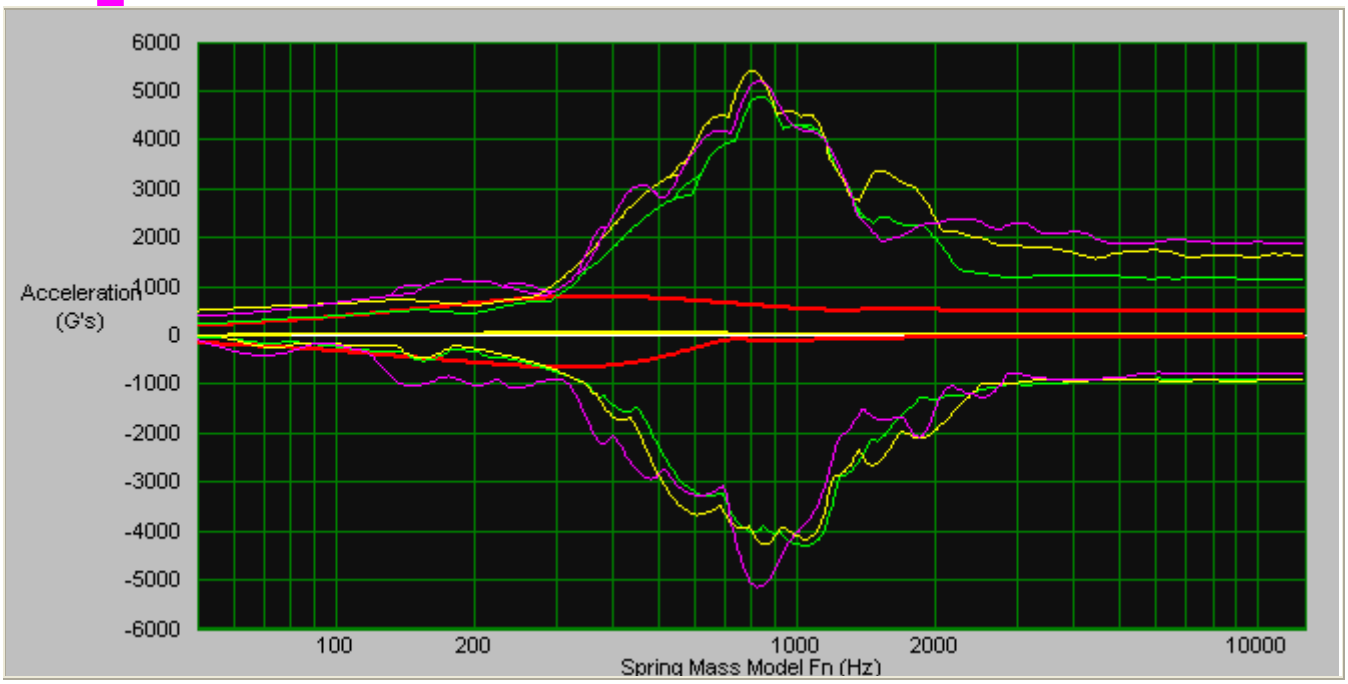
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	498.63	1.94	238.38	1275.51	498.63	-21.75
Ch2	26	1149.70	0.76	210.96	3289.47	1149.70	-882.19
Ch3	146	1574.90	0.64	222.09	3787.88	1574.90	-903.37
Ch4	187 (strain gauged)	1881.38	0.72	299.72	3289.47	1881.38	-759.86



Shock Response Spectra

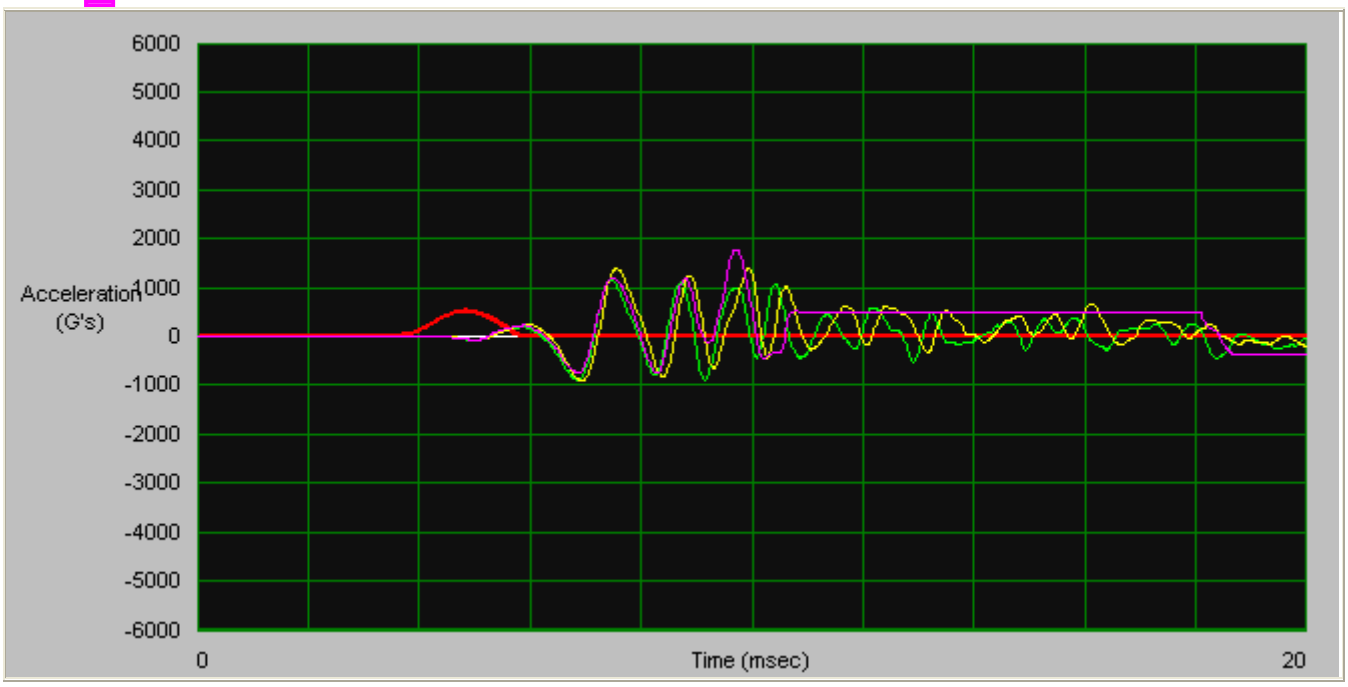
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	786.43	366.80	-662.26	322.10	-	-	-	-
SRS2	Composite	0.05	4887.92	835.42	-4286.03	1052.56	-	-	-	-
SRS3	Composite	0.05	5423.81	800.00	-4277.63	859.90	-	-	-	-
SRS4	Composite	0.05	5206.74	823.44	-5149.25	823.44	-	-	-	-



Card 26, 146, 187 – Drop 4

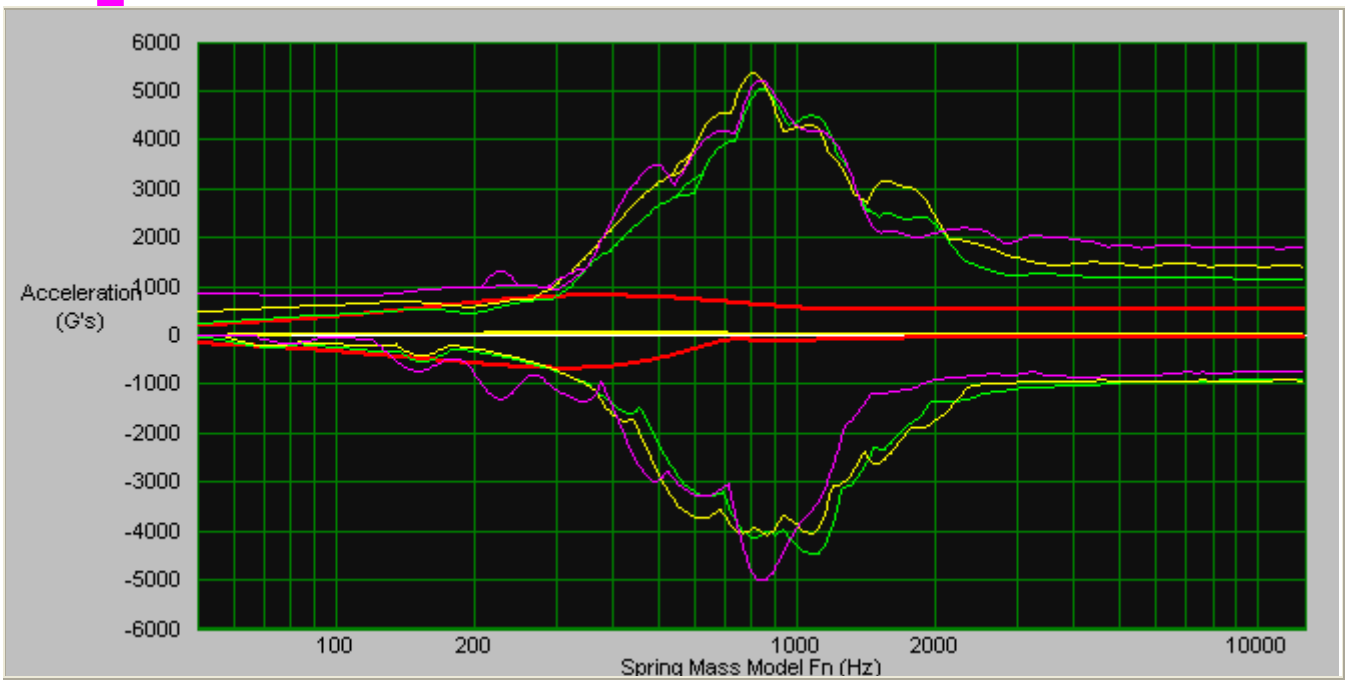
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	512.90	1.94	243.99	1288.66	512.90	-20.18
Ch2	26	1149.28	0.78	211.34	3289.47	1149.28	-899.44
Ch3	146	1399.46	0.64	206.76	2976.19	1399.46	-919.25
Ch4	187 (strain gauged)	1780.71	0.72	306.25	3205.13	1780.71	-744.77



Shock Response Spectra

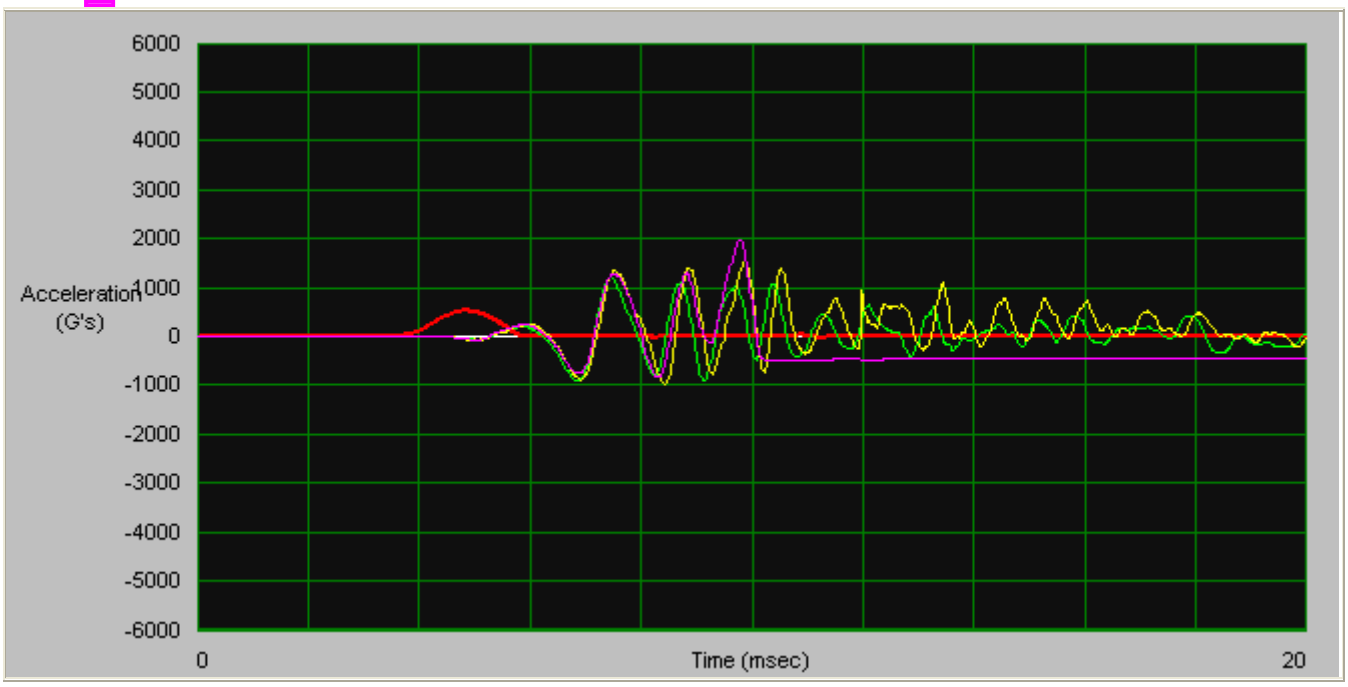
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	807.92	361.54	-680.06	317.48	-	-	-	-
SRS2	Composite	0.05	5025.83	847.57	-4470.46	1099.16	-	-	-	-
SRS3	Composite	0.05	5349.07	800.00	-4077.25	859.90	-	-	-	-
SRS4	Composite	0.05	5216.23	835.42	-5011.54	835.42	-	-	-	-



Card 26, 146, 187 – Drop 5

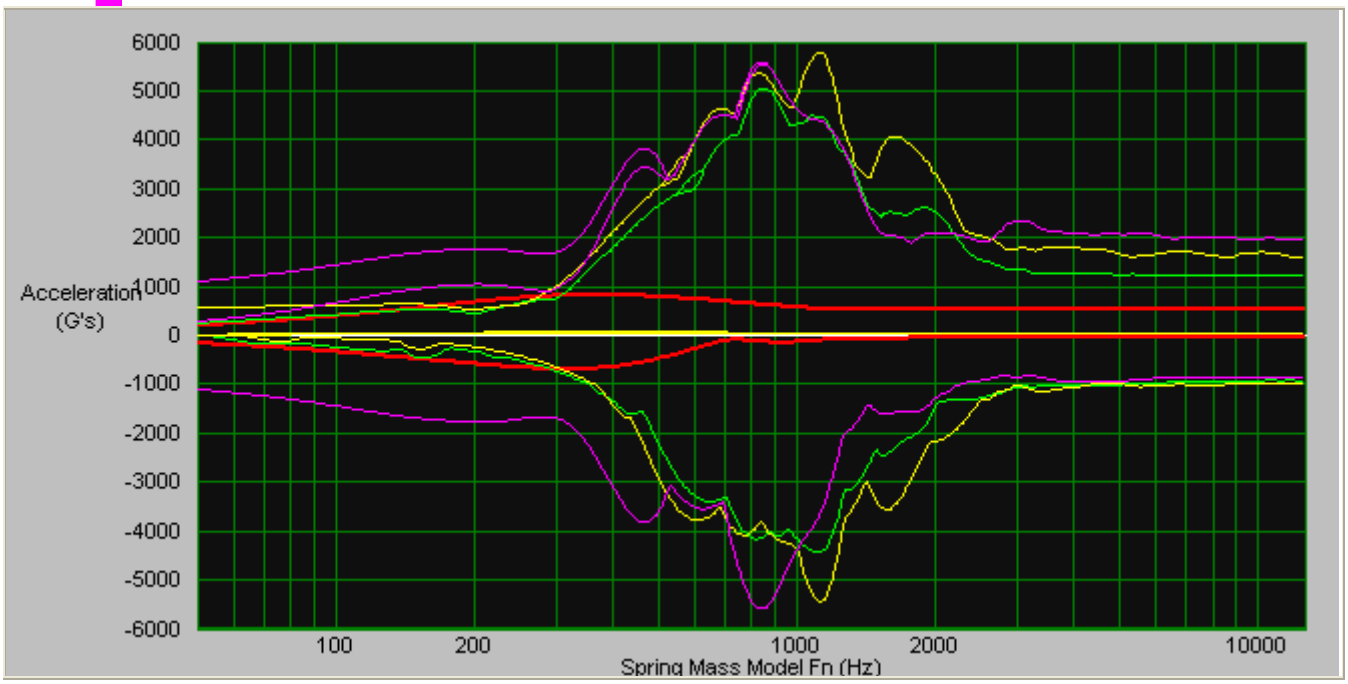
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	519.30	1.94	248.11	1288.66	519.30	-24.69
Ch2	26	1211.63	0.76	214.78	3289.47	1211.63	-912.05
Ch3	146	1547.14	0.58	202.96	4310.34	1547.14	-979.70
Ch4	187 (strain gauged)	1970.36	0.70	332.15	3289.47	1970.36	-836.61



Shock Response Spectra

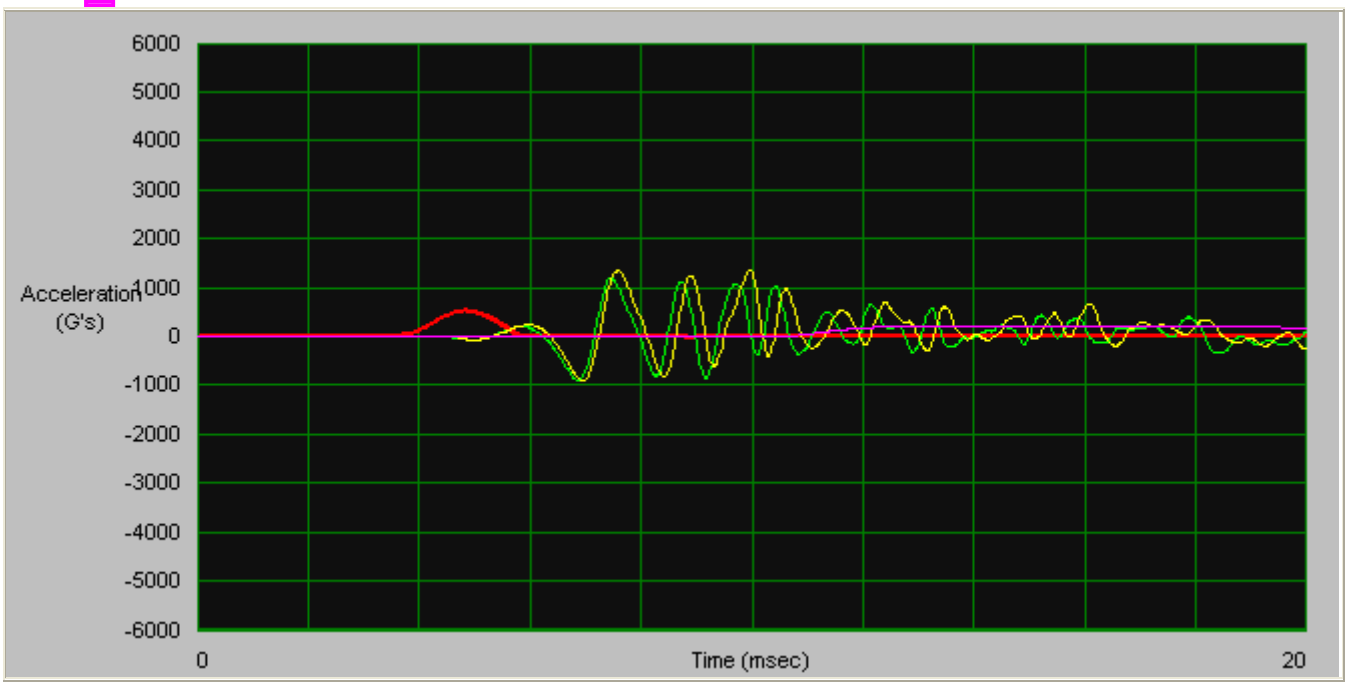
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	819.75	361.54	-693.09	317.48	-	-	-	-
SRS2	Composite	0.05	5055.33	847.57	-4432.80	1115.15	-	-	-	-
SRS3	Composite	0.05	5783.02	1115.15	-5447.59	1131.37	-	-	-	-
SRS4	Composite	0.05	5533.29	847.57	-5586.35	835.42	-	-	-	-



Card 26, 146, 187 – Drop 6

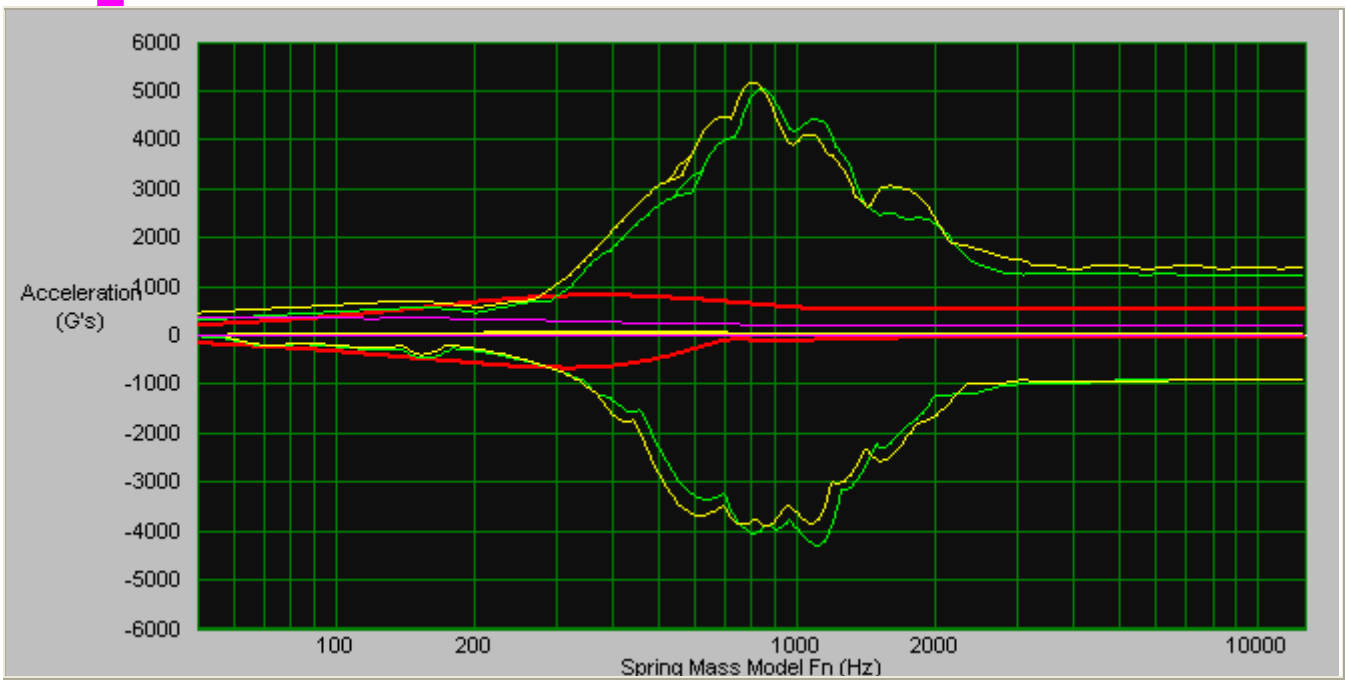
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	514.04	1.94	244.59	1288.66	514.04	-22.03
Ch2	26	1192.90	0.76	214.94	3205.13	1192.90	-885.94
Ch3	146	1347.35	0.70	209.28	2976.19	1347.35	-908.21
Ch4	187 (strain gauged)	207.10	9.18	646.94	264.83	207.10	-0.41



Shock Response Spectra

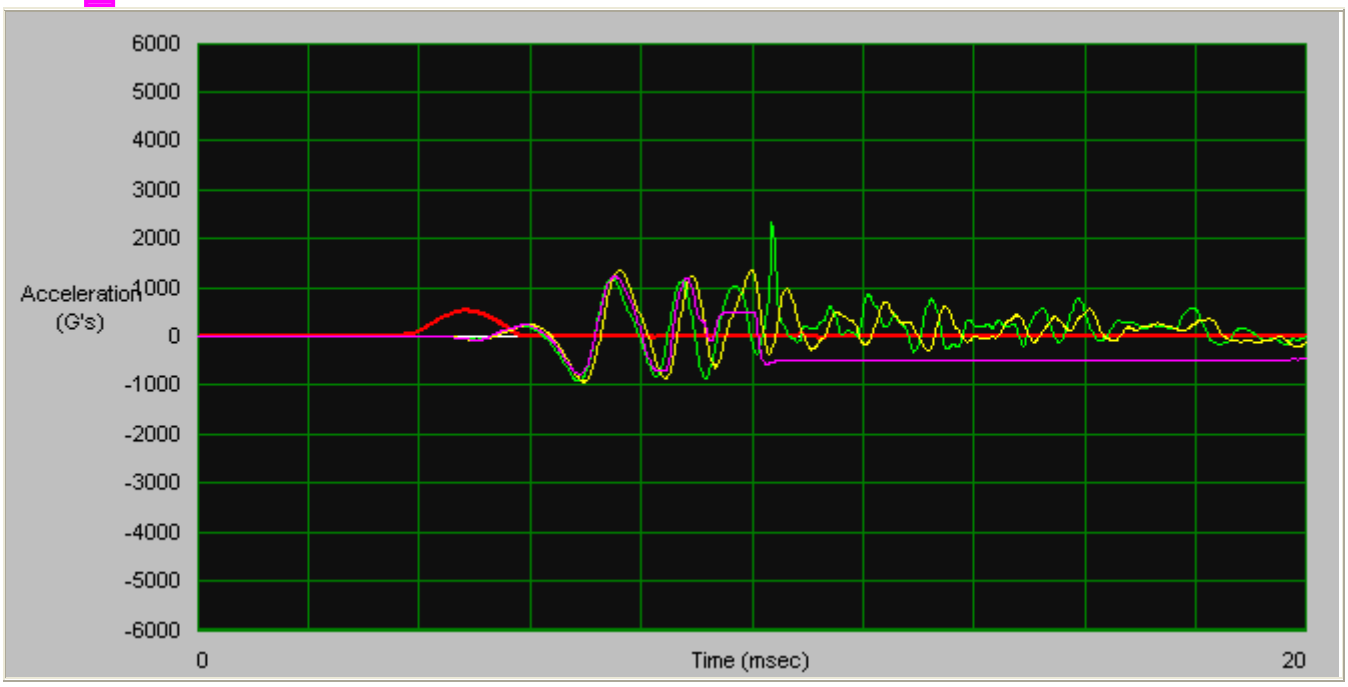
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	811.01	372.14	-676.22	317.48	-	-	-	-
SRS2	Composite	0.05	5027.21	847.57	-4287.26	1115.15	-	-	-	-
SRS3	Composite	0.05	5175.42	800.00	-3889.50	859.90	-	-	-	-
SRS4	Composite	0.05	370.21	76.01	-10.24	117.22	-	-	-	-



Card 26, 146, 187 – Drop 7

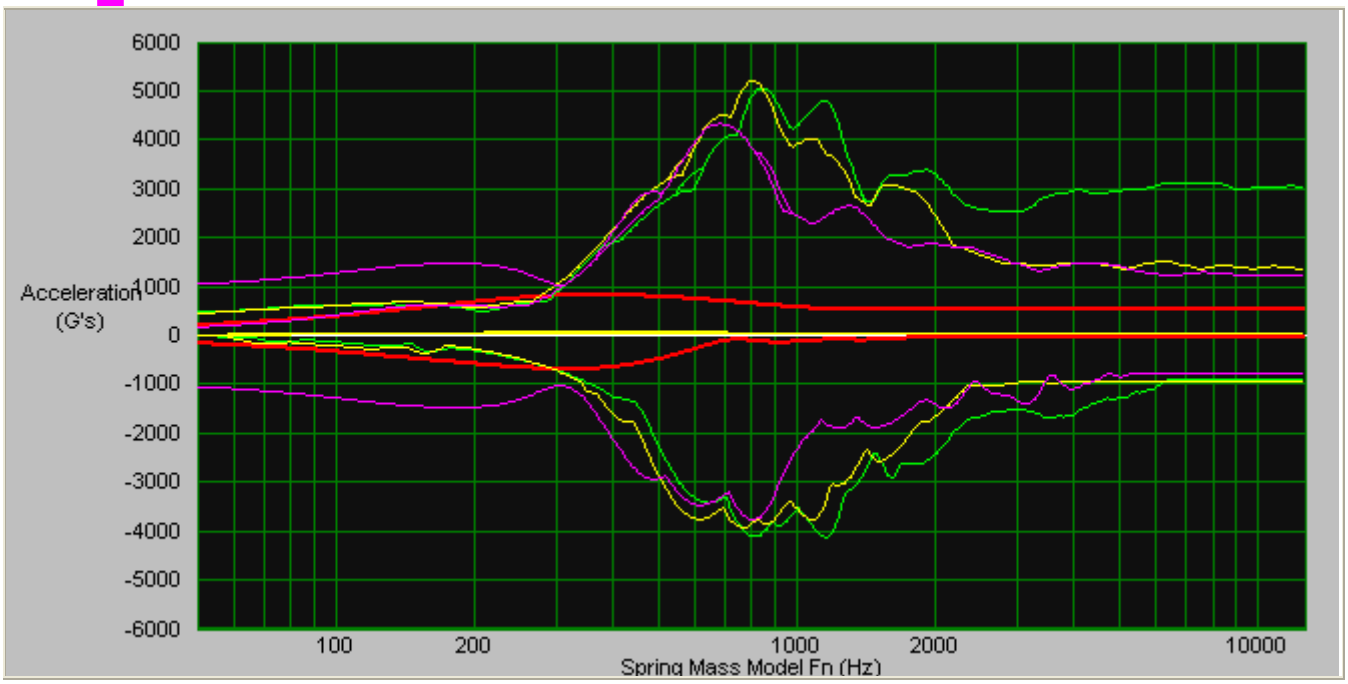
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	519.81	1.92	247.12	1288.66	519.81	-24.49
Ch2	26	2351.60	0.36	132.39	3289.47	2351.60	-904.43
Ch3	146	1357.77	0.66	204.69	2976.19	1357.77	-927.75
Ch4	187 (strain gauged)	1222.65	0.84	252.29	3048.78	1222.65	-775.67



Shock Response Spectra

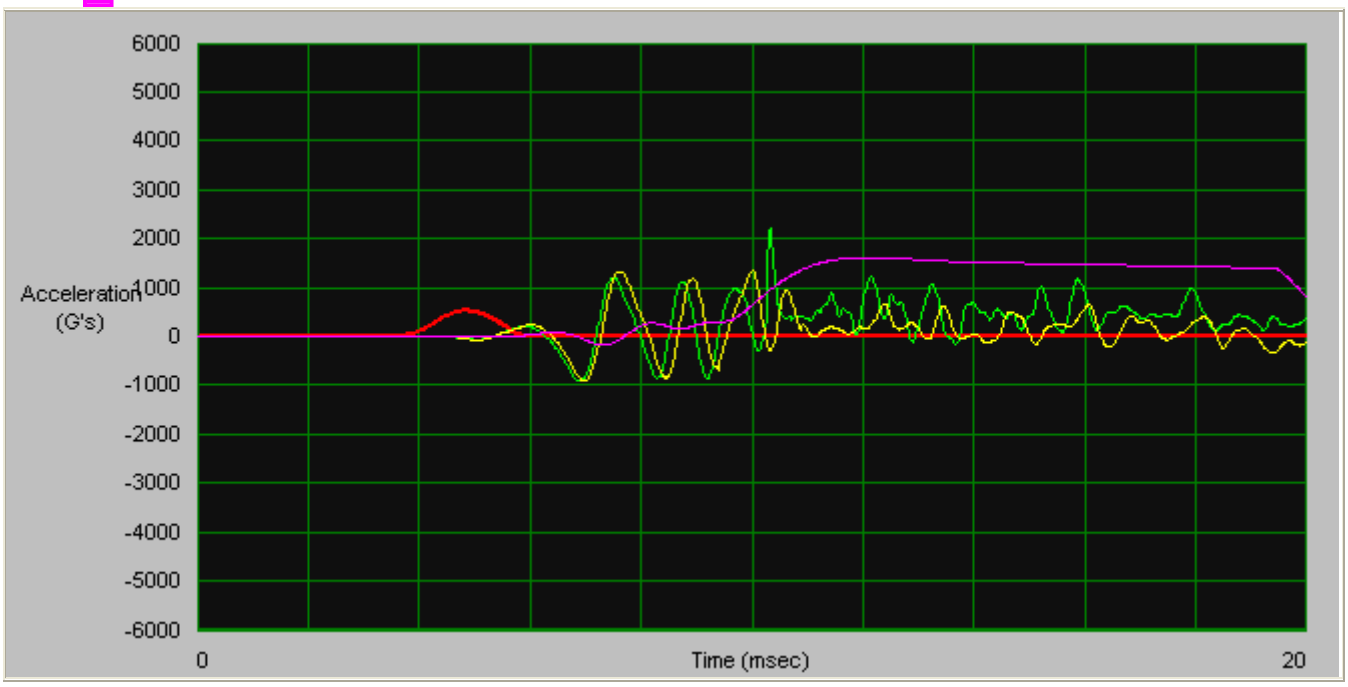
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	822.14	372.14	-692.44	322.10	-	-	-	-
SRS2	Composite	0.05	5057.18	847.57	-4126.90	1147.83	-	-	-	-
SRS3	Composite	0.05	5209.00	800.00	-3933.63	766.08	-	-	-	-
SRS4	Composite	0.05	4323.20	682.50	-3775.88	800.00	-	-	-	-



Card 26, 146, 187 – Drop 8

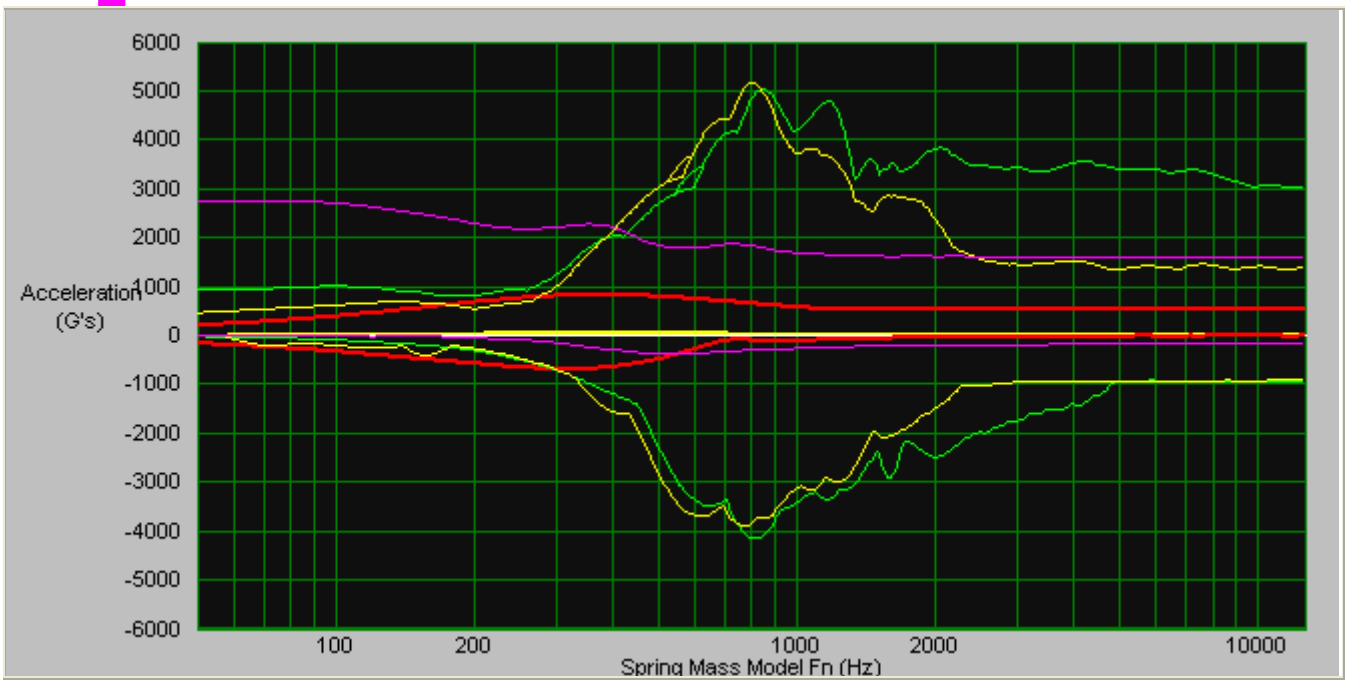
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	518.59	1.92	245.61	1302.08	518.59	-19.75
Ch2	26	2197.10	1.60	382.76	3289.47	2197.10	-917.87
Ch3	146	1333.34	0.68	204.86	3048.78	1333.34	-909.43
Ch4	187 (strain gauged)	1615.94	11.24	5759.66	247.52	1615.94	-179.27



Shock Response Spectra

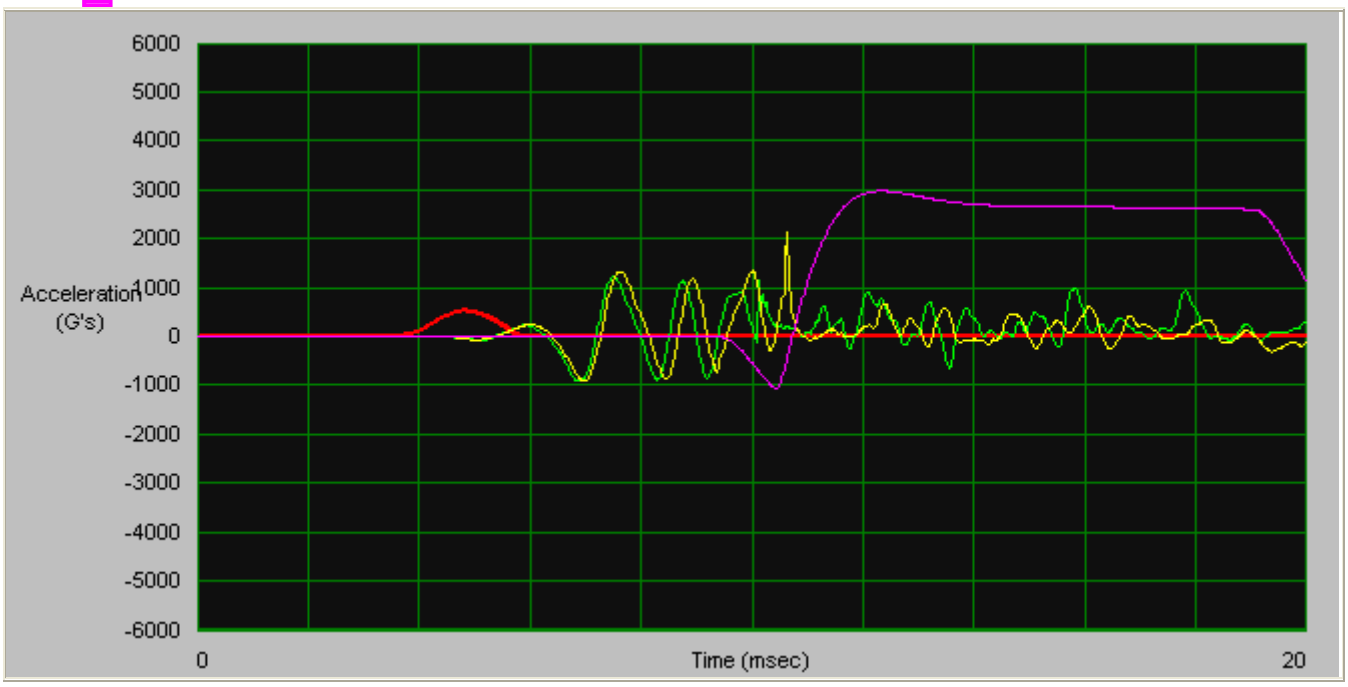
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	821.34	372.14	-688.63	317.48	-	-	-	-
SRS2	Composite	0.05	5023.81	847.57	-4150.46	811.64	-	-	-	-
SRS3	Composite	0.05	5170.66	800.00	-3893.64	766.08	-	-	-	-
SRS4	Composite	0.05	2758.39	67.71	-376.40	565.69	-	-	-	-



Card 26, 146, 187 – Drop 9

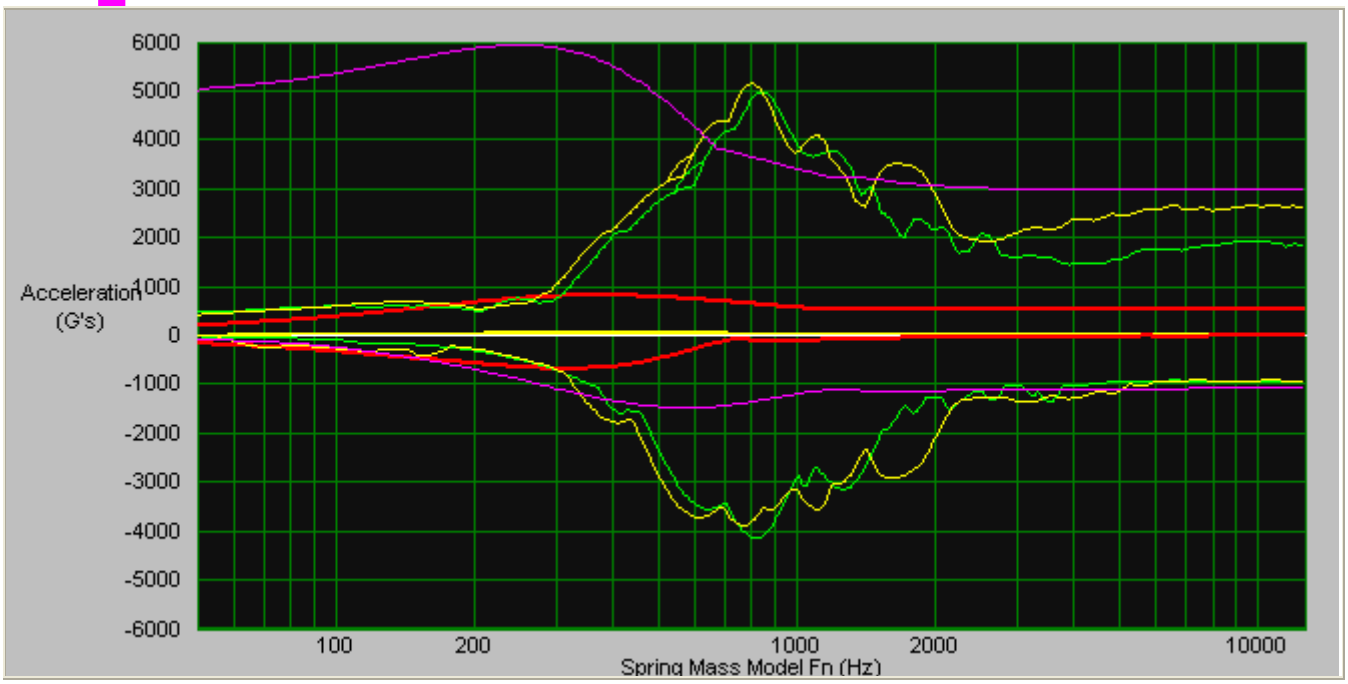
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	515.95	1.94	244.36	1302.08	515.95	-18.86
Ch2	26	1223.43	0.76	220.26	3289.47	1223.43	-918.68
Ch3	146	2110.07	0.36	118.07	3048.78	2110.07	-919.07
Ch4	187 (strain gauged)	2973.32	9.22	9021.96	281.53	2973.32	-1067.78



Shock Response Spectra

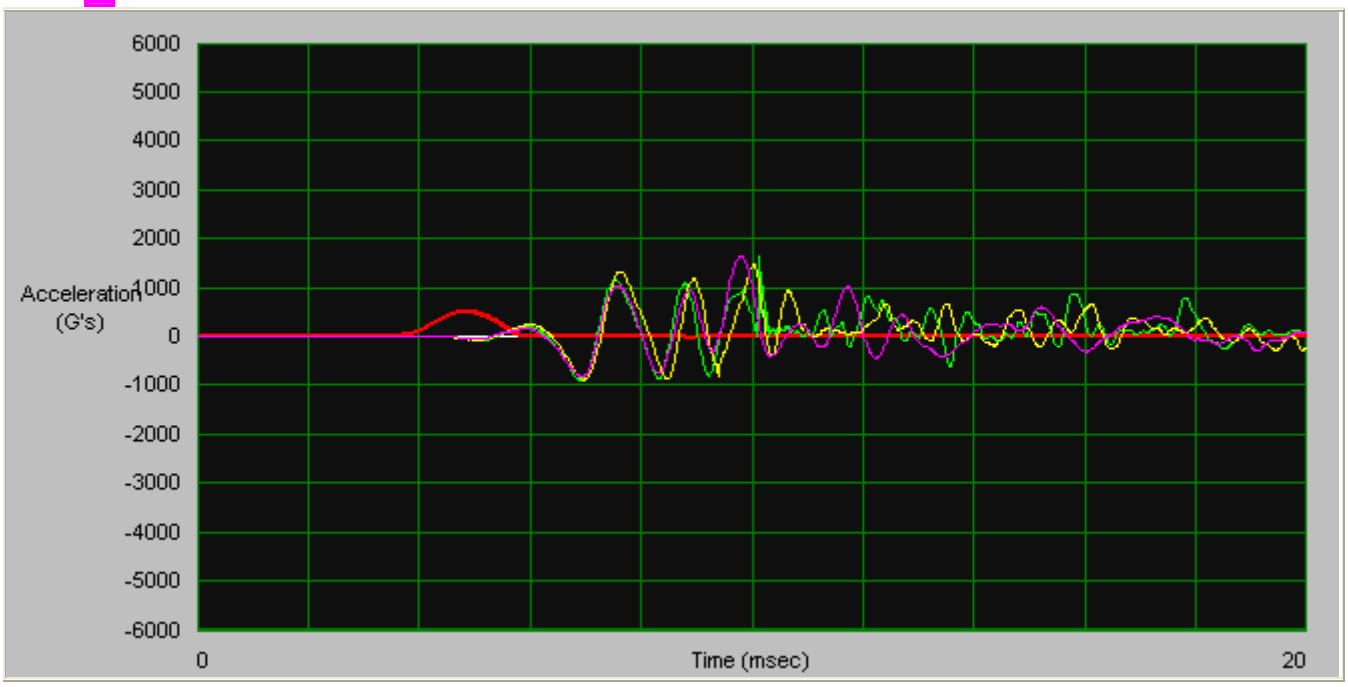
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	812.83	366.80	-683.77	317.48	-	-	-	-
SRS2	Composite	0.05	4966.69	835.42	-4144.89	811.64	-	-	-	-
SRS3	Composite	0.05	5145.65	800.00	-3891.86	766.08	-	-	-	-
SRS4	Composite	0.05	5934.74	251.98	-1478.32	565.69	-	-	-	-



Card 26, 146, 187 – Drop 10

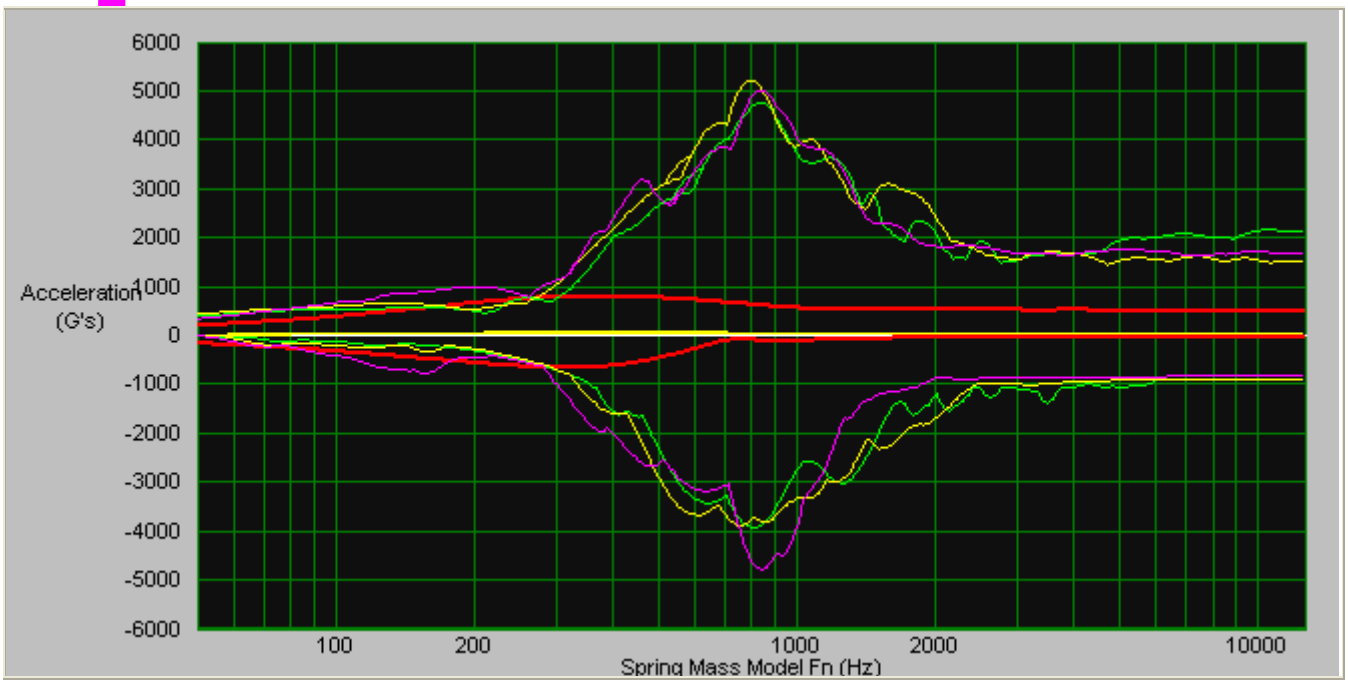
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	508.22	1.94	240.55	1302.08	508.22	-23.77
Ch2	26	1628.33	0.20	47.18	3289.47	1628.33	-894.03
Ch3	146	1468.38	0.60	204.86	3787.88	1468.38	-891.65
Ch4	187 (strain gauged)	1651.46	0.72	290.26	3289.47	1651.46	-825.91



Shock Response Spectra

	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	798.03	372.14	-662.49	317.48	-	-	-	-
SRS2	Composite	0.05	4747.49	835.42	-3934.69	811.64	-	-	-	-
SRS3	Composite	0.05	5220.75	788.53	-3884.59	755.10	-	-	-	-
SRS4	Composite	0.05	5005.45	835.42	-4780.58	835.42	-	-	-	-

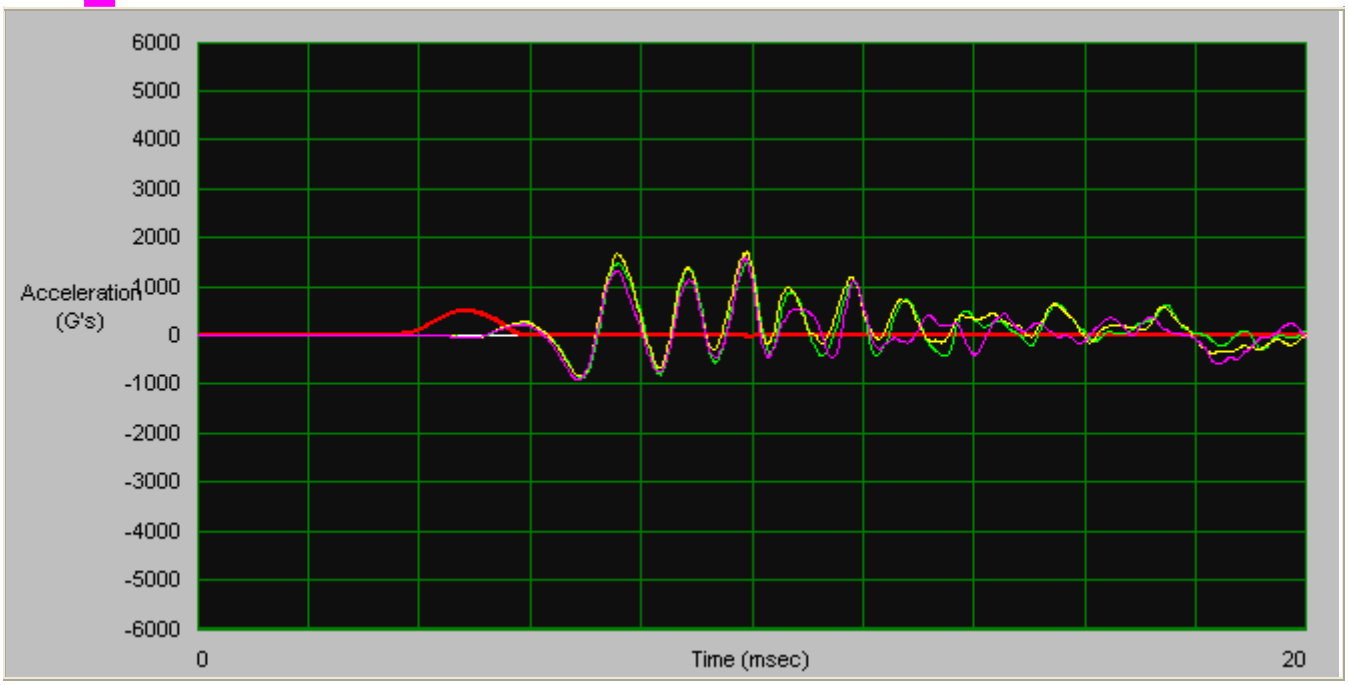


11.3 Set 3 – Card 59, 147, 188

Card 59, 147, 188 – Drop 1

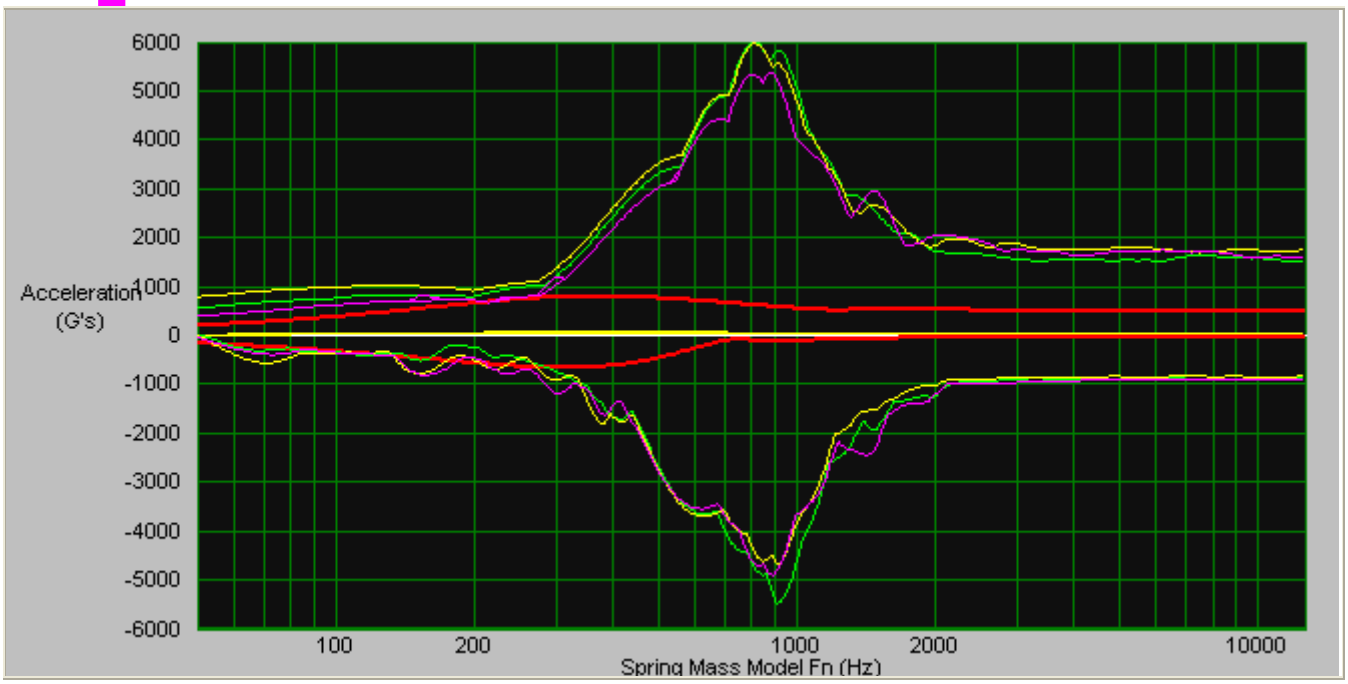
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	502.86	1.94	239.19	1288.66	502.86	-22.06
Ch2	147	1493.75	0.66	239.62	2976.19	1493.75	-877.18
Ch3	59	1720.14	0.70	281.03	2906.98	1720.14	-838.20
Ch4	188	1578.00	0.58	214.03	4032.26	1578.00	-904.18



Shock Response Spectra

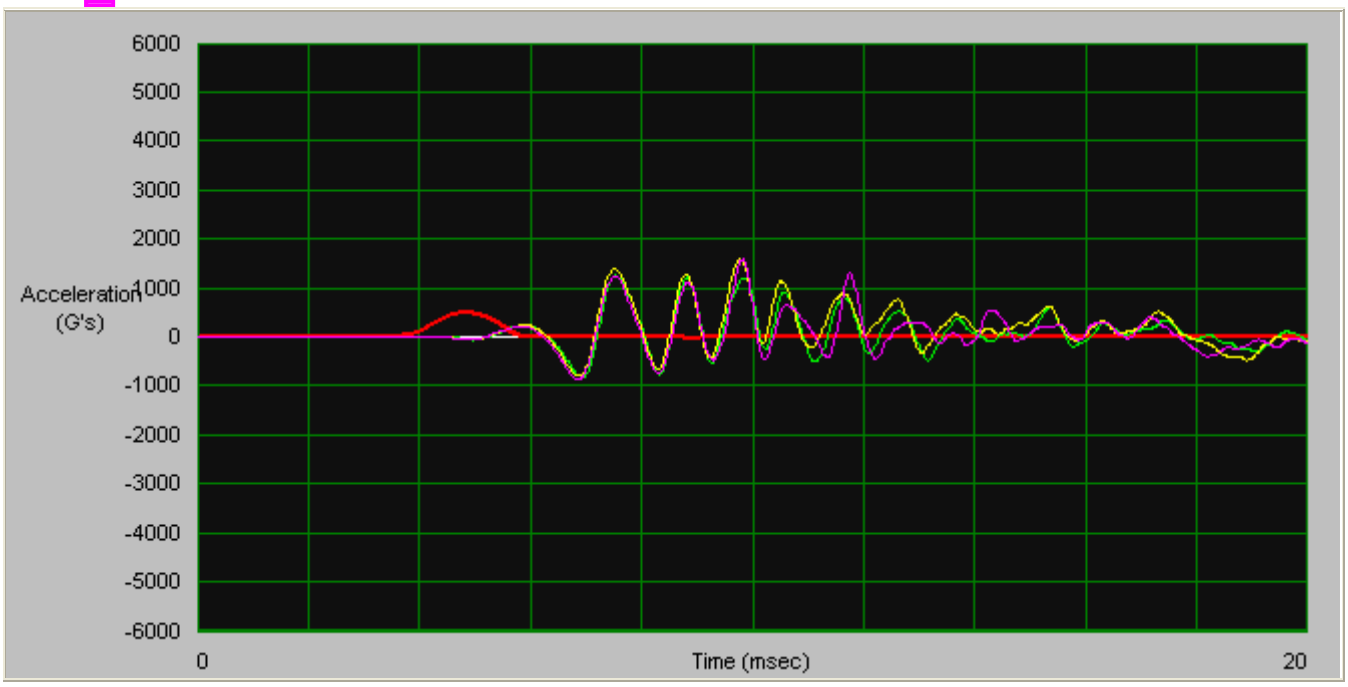
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	792.09	361.54	-669.52	317.48	-	-	-	-
SRS2	Composite	0.05	5997.86	811.64	-5479.50	911.03	-	-	-	-
SRS3	Composite	0.05	5969.26	811.64	-4670.97	911.03	-	-	-	-
SRS4	Composite	0.05	5376.03	872.41	-4900.38	885.10	-	-	-	-



Card 59, 147, 188 – Drop 2

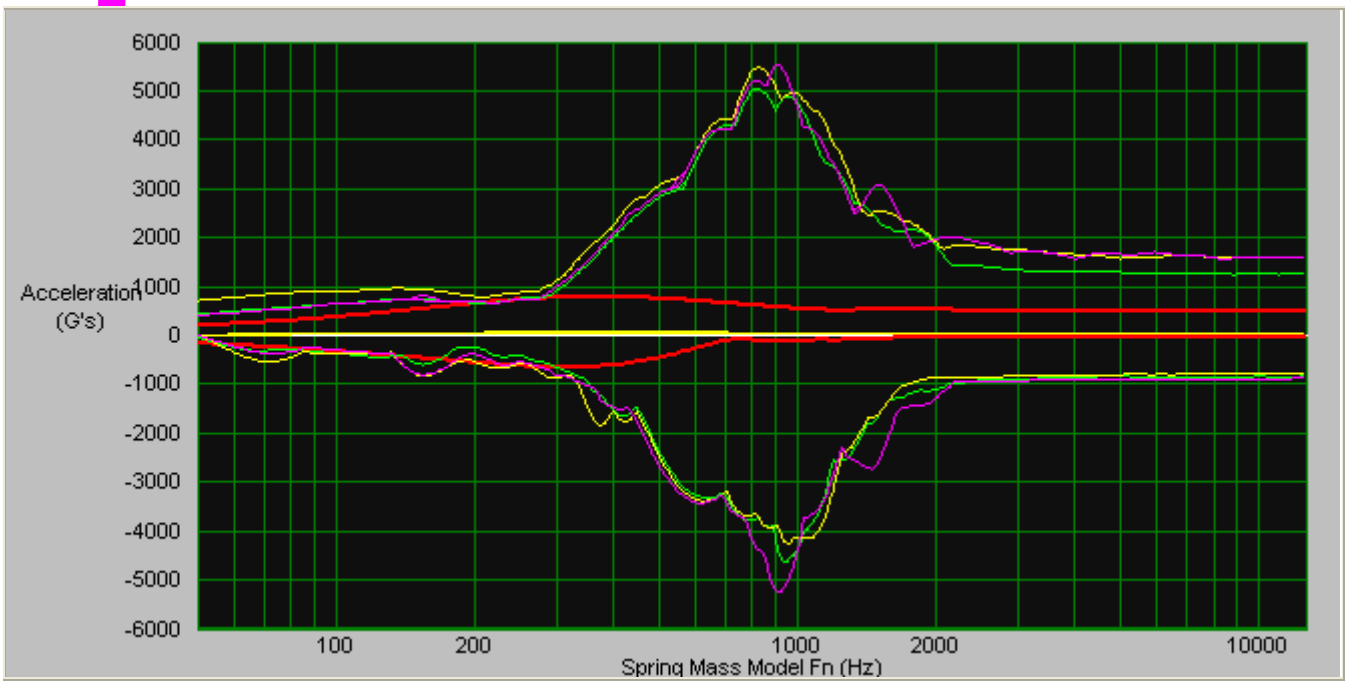
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	499.93	1.94	237.57	1288.66	499.93	-26.62
Ch2	147	1249.41	0.82	253.06	3048.78	1249.41	-829.79
Ch3	59	1577.20	0.66	258.74	3378.38	1577.20	-789.46
Ch4	188	1581.91	0.56	215.63	4032.26	1581.91	-876.17



Shock Response Spectra

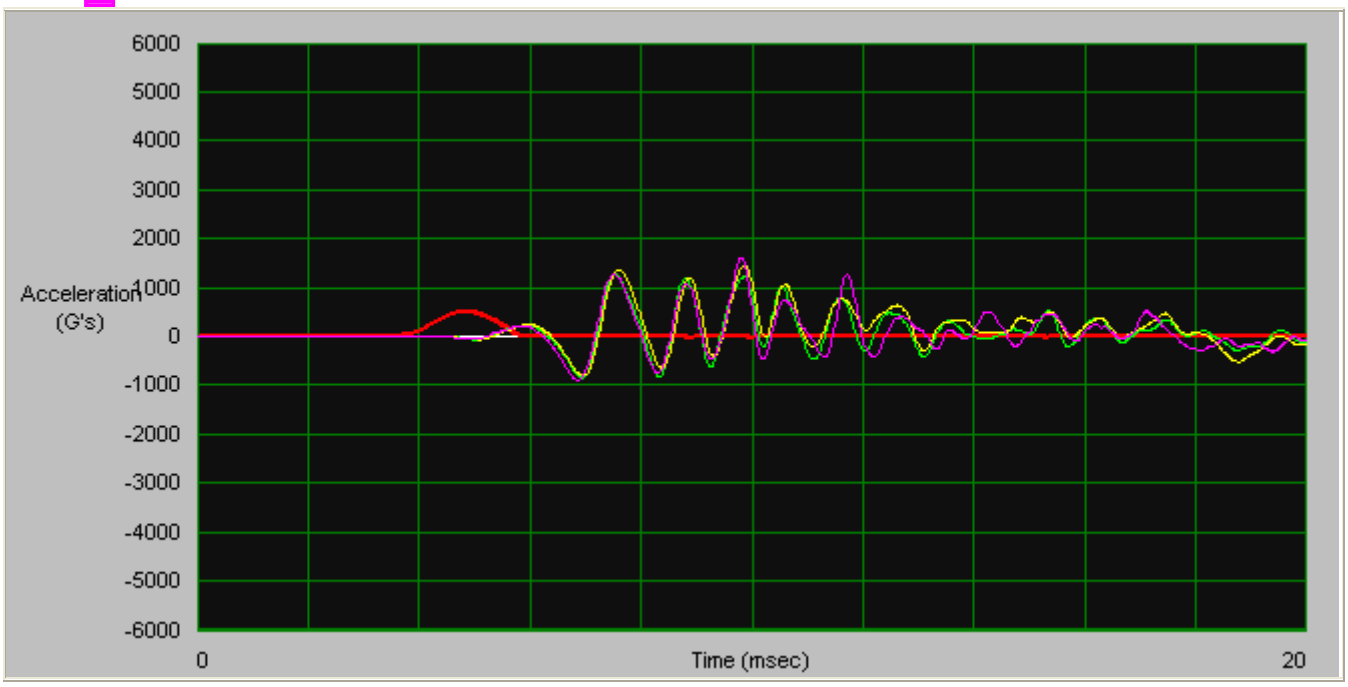
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	783.35	361.54	-654.61	317.48	-	-	-	-
SRS2	Composite	0.05	5031.54	823.44	-4633.66	937.73	-	-	-	-
SRS3	Composite	0.05	5471.92	823.44	-4272.18	951.37	-	-	-	-
SRS4	Composite	0.05	5536.61	911.03	-5255.00	911.03	-	-	-	-



Card 59, 147, 188 – Drop 3

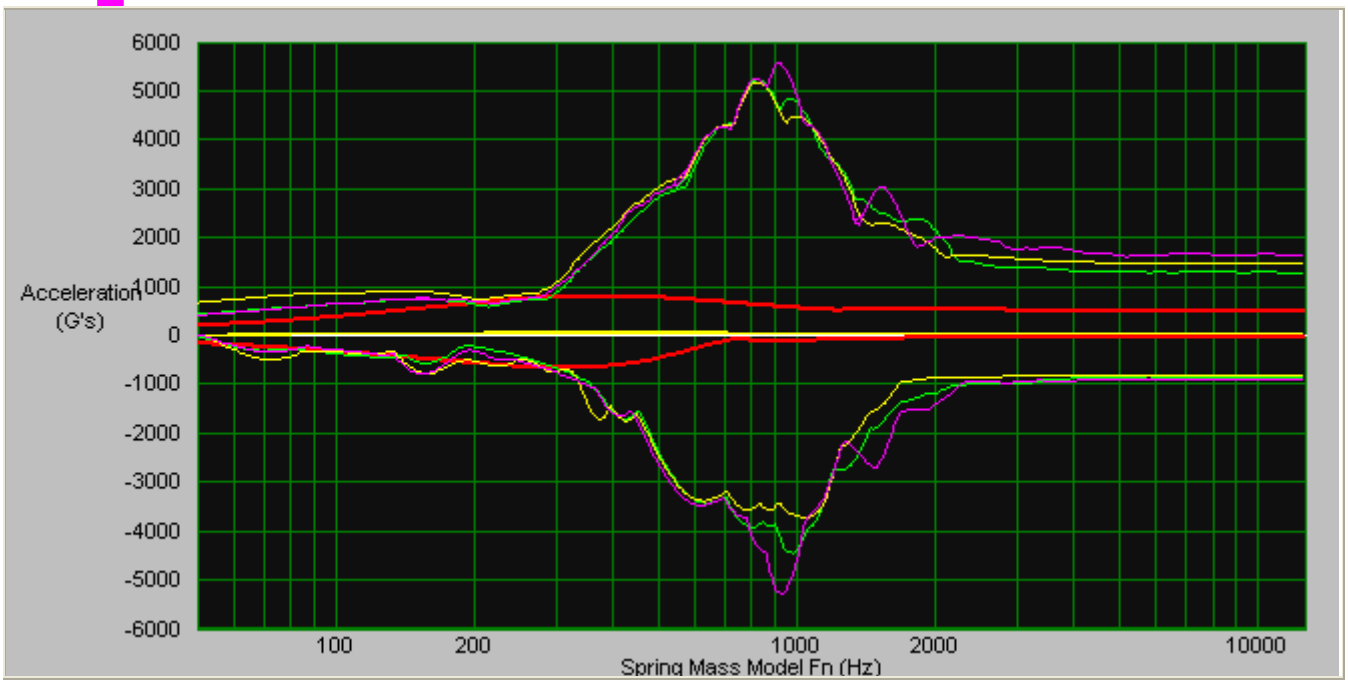
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	506.96	1.94	240.21	1302.08	506.96	-21.36
Ch2	147	1278.14	0.80	247.39	3125.00	1278.14	-842.16
Ch3	59	1454.33	0.68	239.98	1736.11	1454.33	-801.55
Ch4	188	1612.16	0.58	218.55	4032.26	1612.16	-893.84



Shock Response Spectra

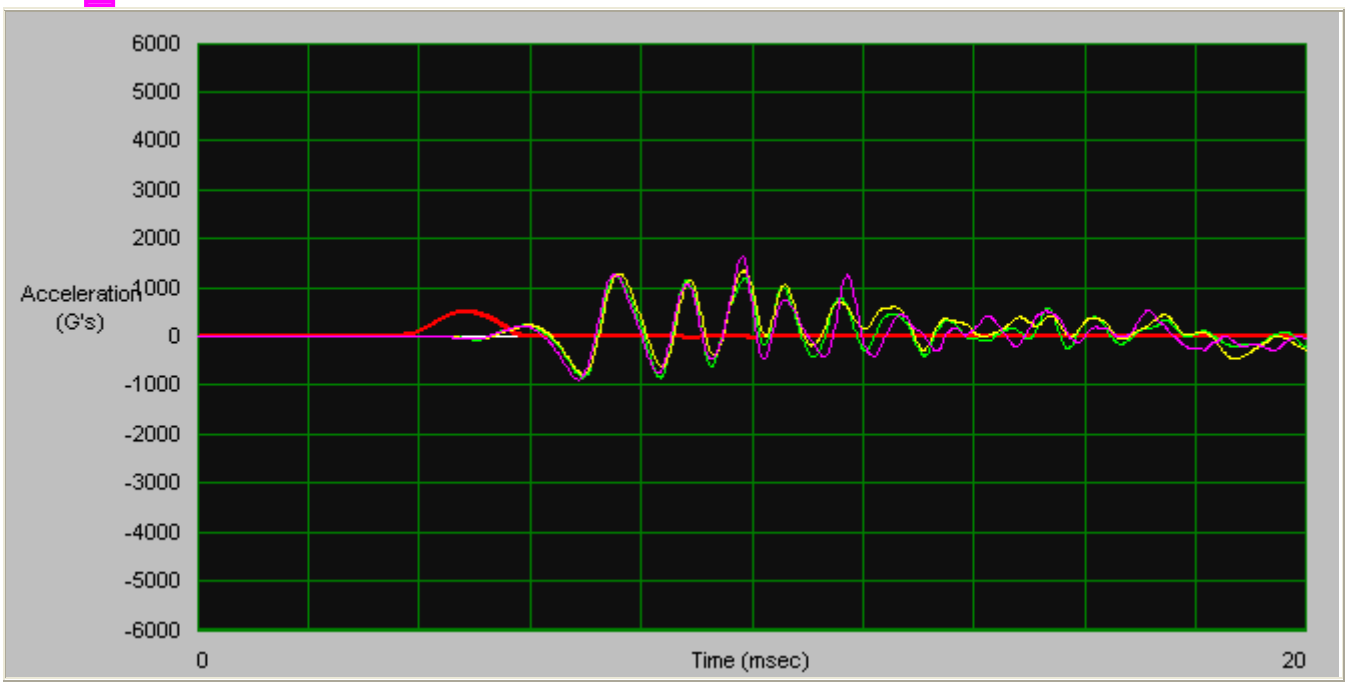
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	796.06	361.54	-671.60	317.48	-	-	-	-
SRS2	Composite	0.05	5222.69	823.44	-4444.52	979.24	-	-	-	-
SRS3	Composite	0.05	5167.31	823.44	-3732.73	1052.56	-	-	-	-
SRS4	Composite	0.05	5557.02	911.03	-5291.99	924.28	-	-	-	-



Card 59, 147, 188 – Drop 4

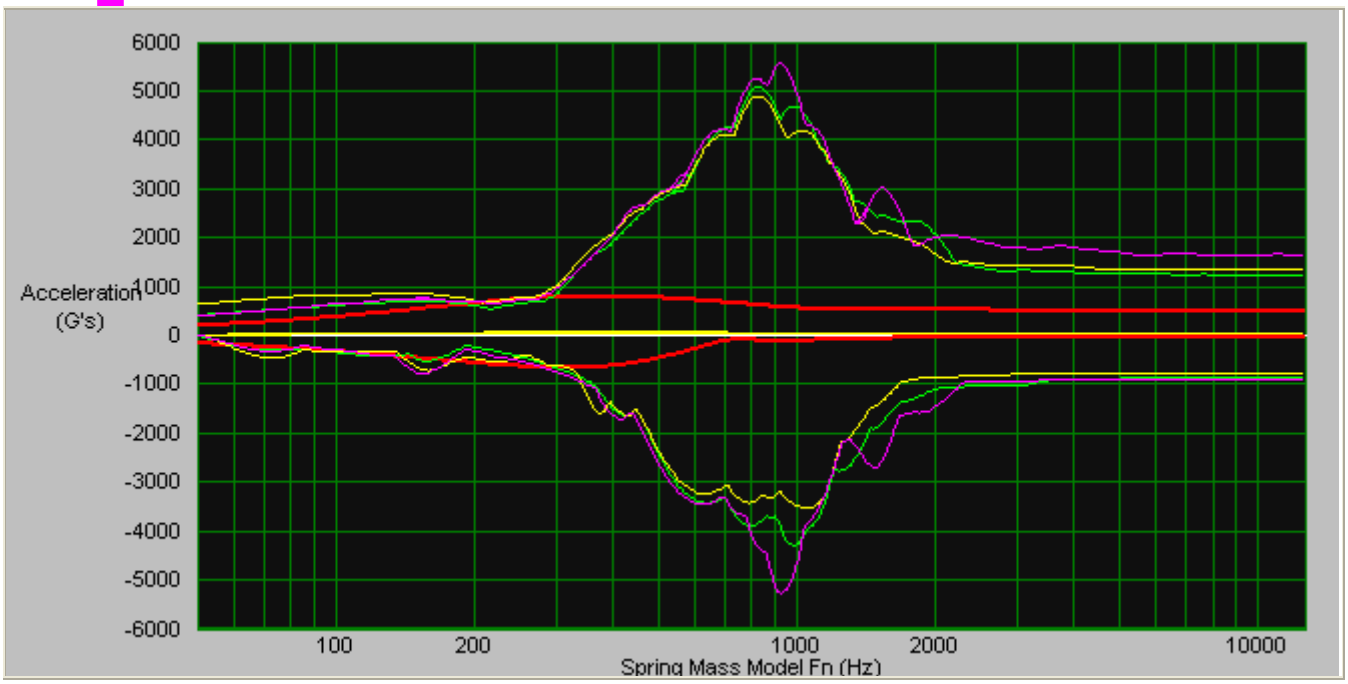
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	506.30	1.92	239.41	1288.66	506.30	-24.82
Ch2	147	1236.14	0.80	240.70	3048.78	1236.14	-847.82
Ch3	59	1335.93	0.70	227.13	1736.11	1335.93	-767.28
Ch4	188	1627.33	0.60	221.30	4032.26	1627.33	-886.27



Shock Response Spectra

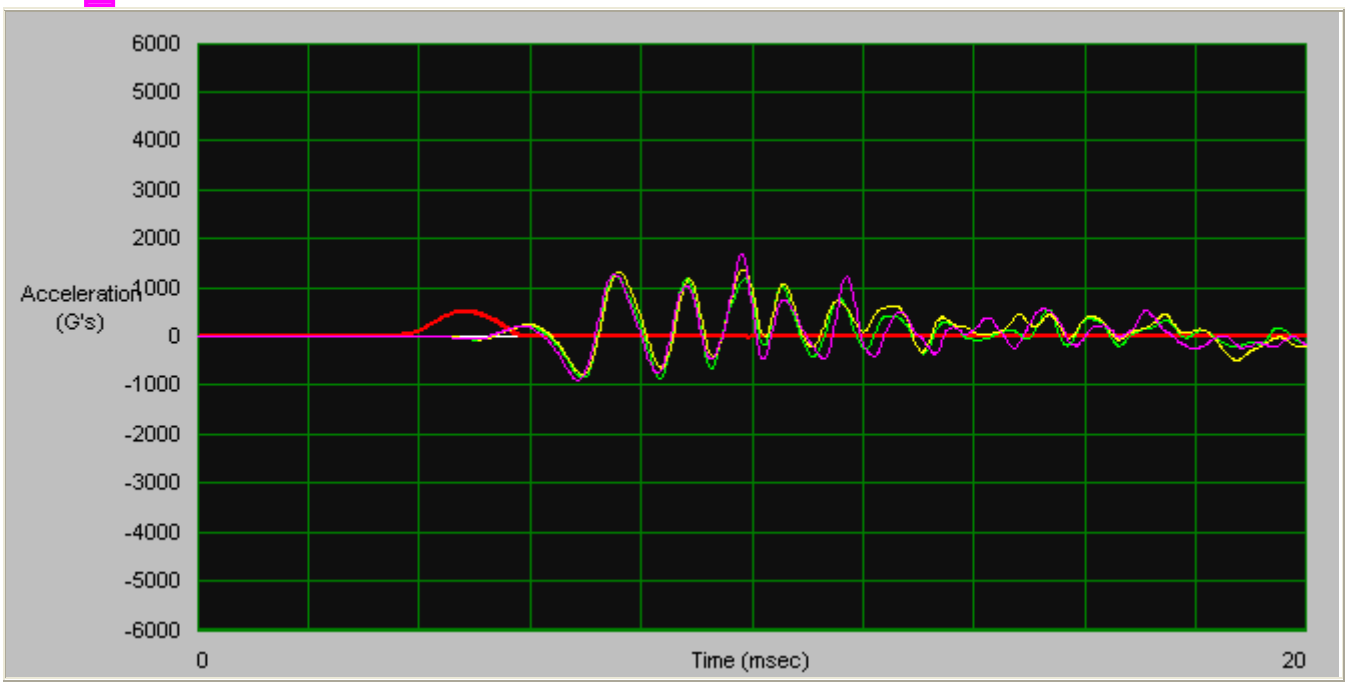
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	795.57	372.14	-664.09	322.10	-	-	-	-
SRS2	Composite	0.05	5079.37	823.44	-4306.80	979.24	-	-	-	-
SRS3	Composite	0.05	4894.04	823.44	-3538.00	1067.87	-	-	-	-
SRS4	Composite	0.05	5554.50	924.28	-5272.72	924.28	-	-	-	-



Card 59, 147, 188 – Drop 5

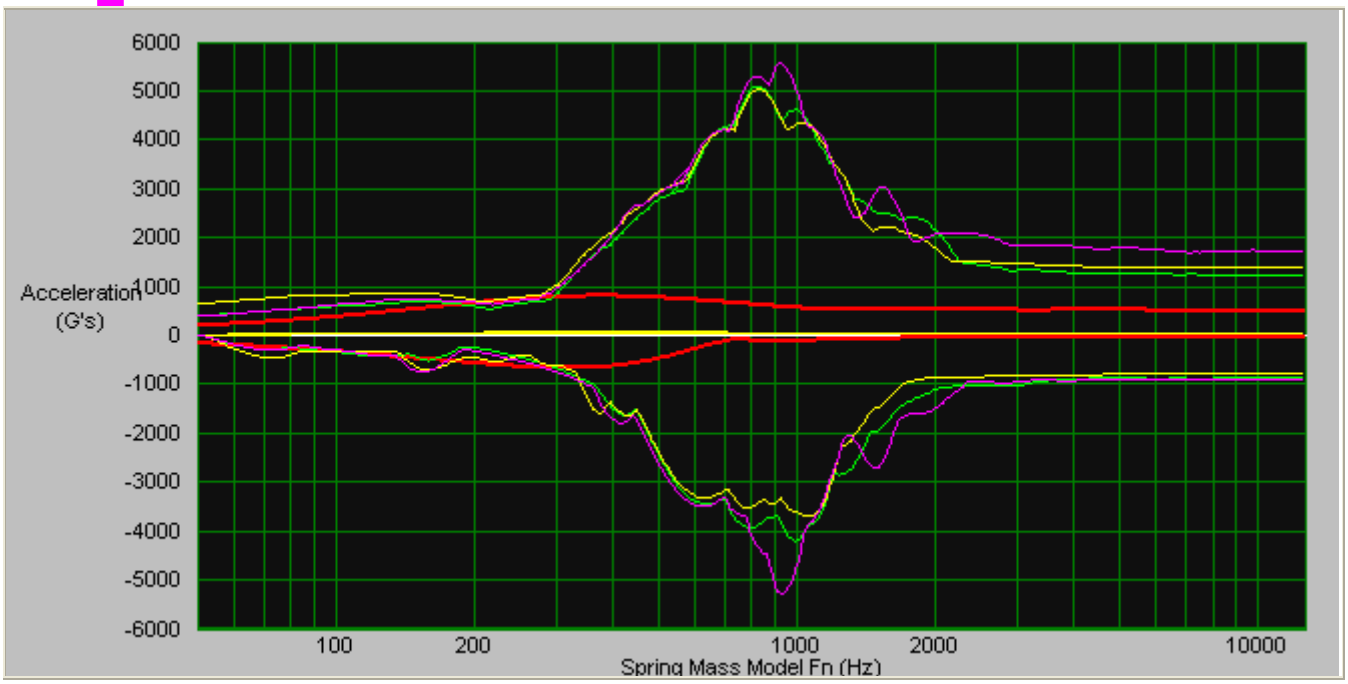
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	509.12	1.94	240.72	1302.08	509.12	-20.66
Ch2	147	1230.17	0.80	239.01	3125.00	1230.17	-856.00
Ch3	59	1371.41	0.70	228.49	1760.56	1371.41	-785.83
Ch4	188	1680.87	0.58	222.02	4166.67	1680.87	-893.45



Shock Response Spectra

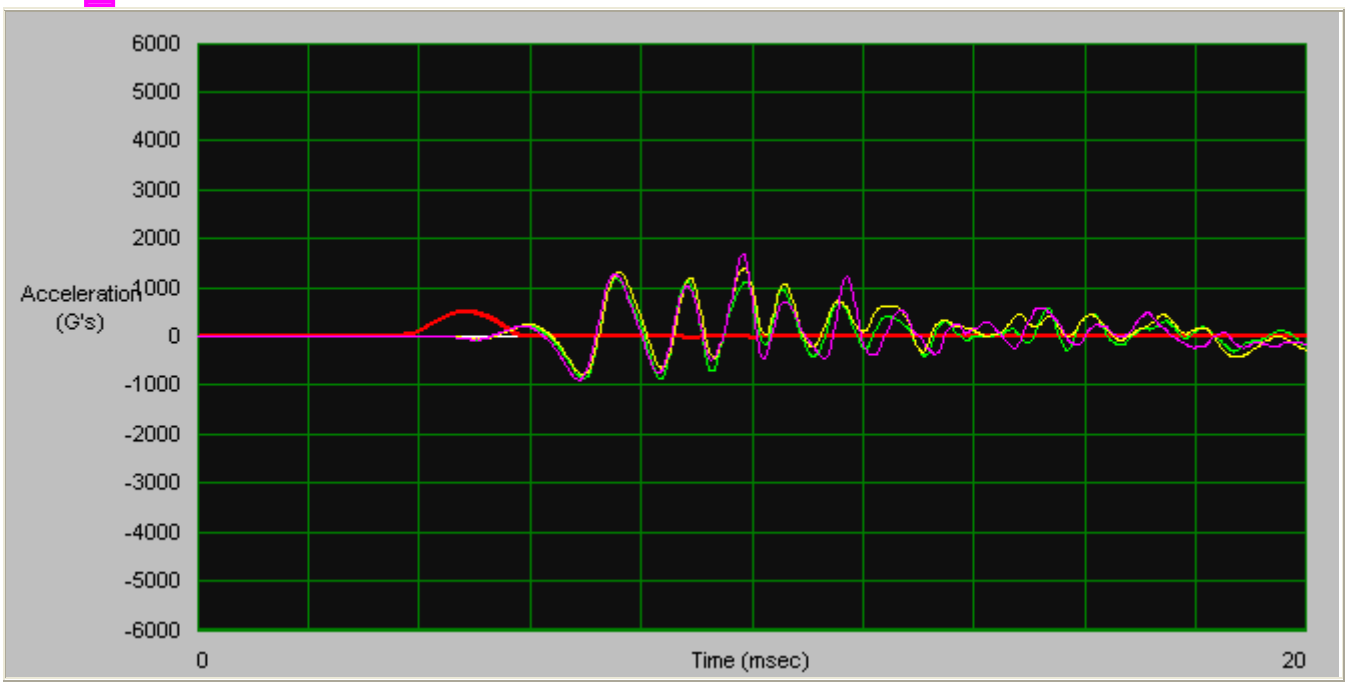
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	801.84	372.14	-673.96	317.48	-	-	-	-
SRS2	Composite	0.05	5091.75	823.44	-4207.92	993.49	-	-	-	-
SRS3	Composite	0.05	5028.51	823.44	-3676.94	1052.56	-	-	-	-
SRS4	Composite	0.05	5562.48	924.28	-5276.29	924.28	-	-	-	-



Card 59, 147, 188 – Drop 6

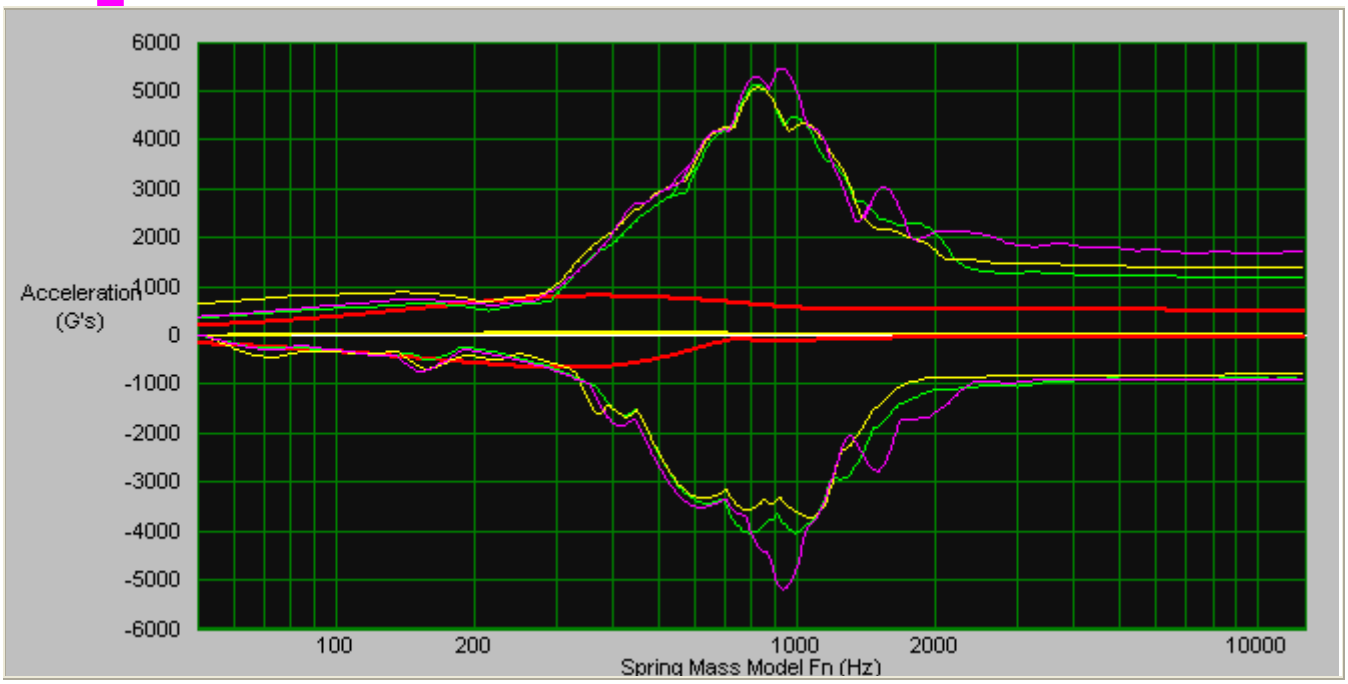
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	509.56	1.92	239.60	1302.08	509.56	-26.19
Ch2	147	1186.11	0.78	228.55	3125.00	1186.11	-864.35
Ch3	59	1384.80	0.68	230.48	1760.56	1384.80	-791.23
Ch4	188	1678.10	0.56	223.55	4032.26	1678.10	-888.28



Shock Response Spectra

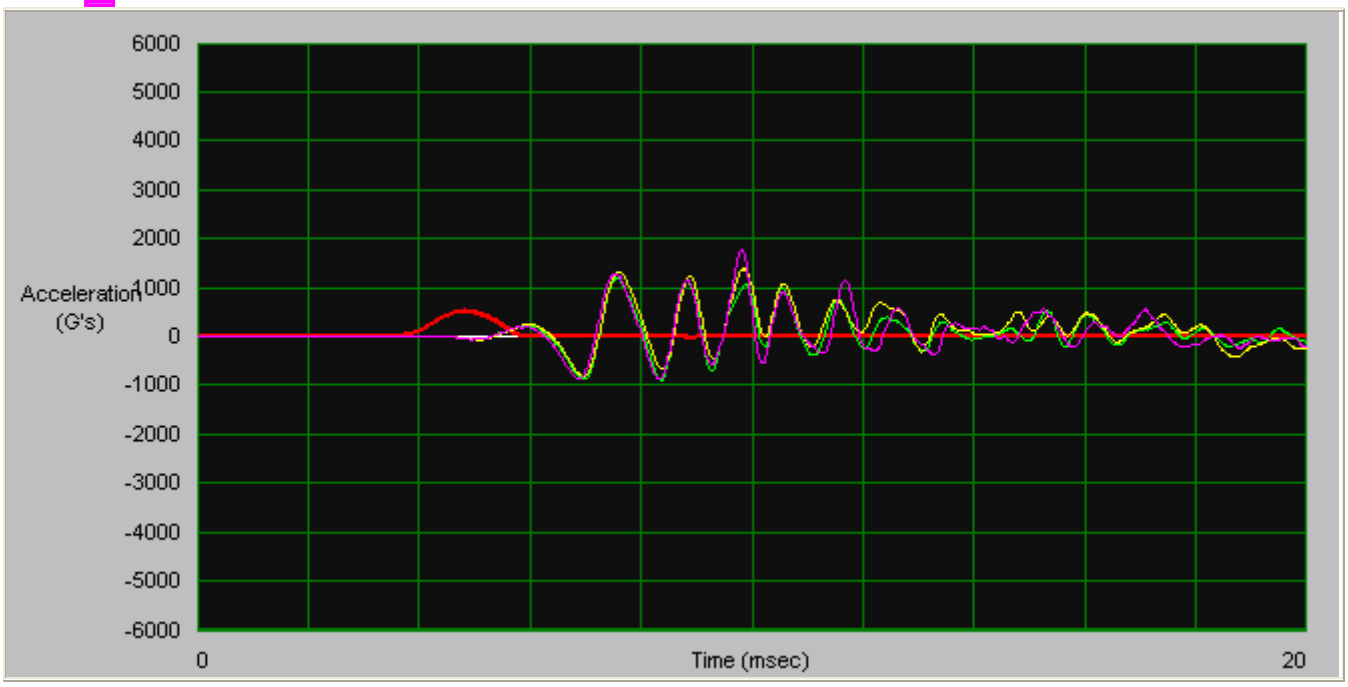
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	800.65	366.80	-670.61	317.48	-	-	-	-
SRS2	Composite	0.05	5112.71	823.44	-4040.36	788.53	-	-	-	-
SRS3	Composite	0.05	5065.33	823.44	-3724.48	1067.87	-	-	-	-
SRS4	Composite	0.05	5460.90	924.28	-5190.26	937.73	-	-	-	-



Card 59, 147, 188 – Drop 7

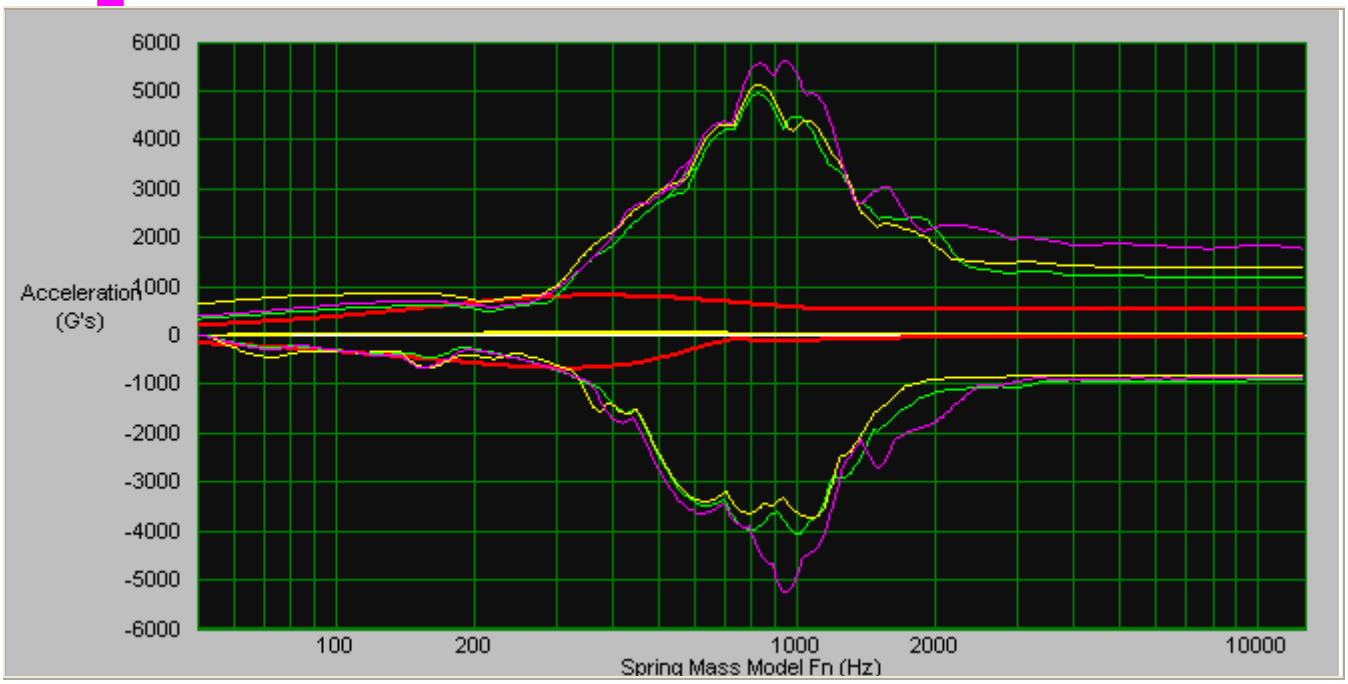
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	512.46	1.94	241.86	1302.08	512.46	-20.90
Ch2	147	1191.31	0.78	226.28	3125.00	1191.31	-901.78
Ch3	59	1376.62	0.68	227.63	1785.71	1376.62	-811.46
Ch4	188	1768.84	0.52	224.91	4166.67	1768.84	-861.46



Shock Response Spectra

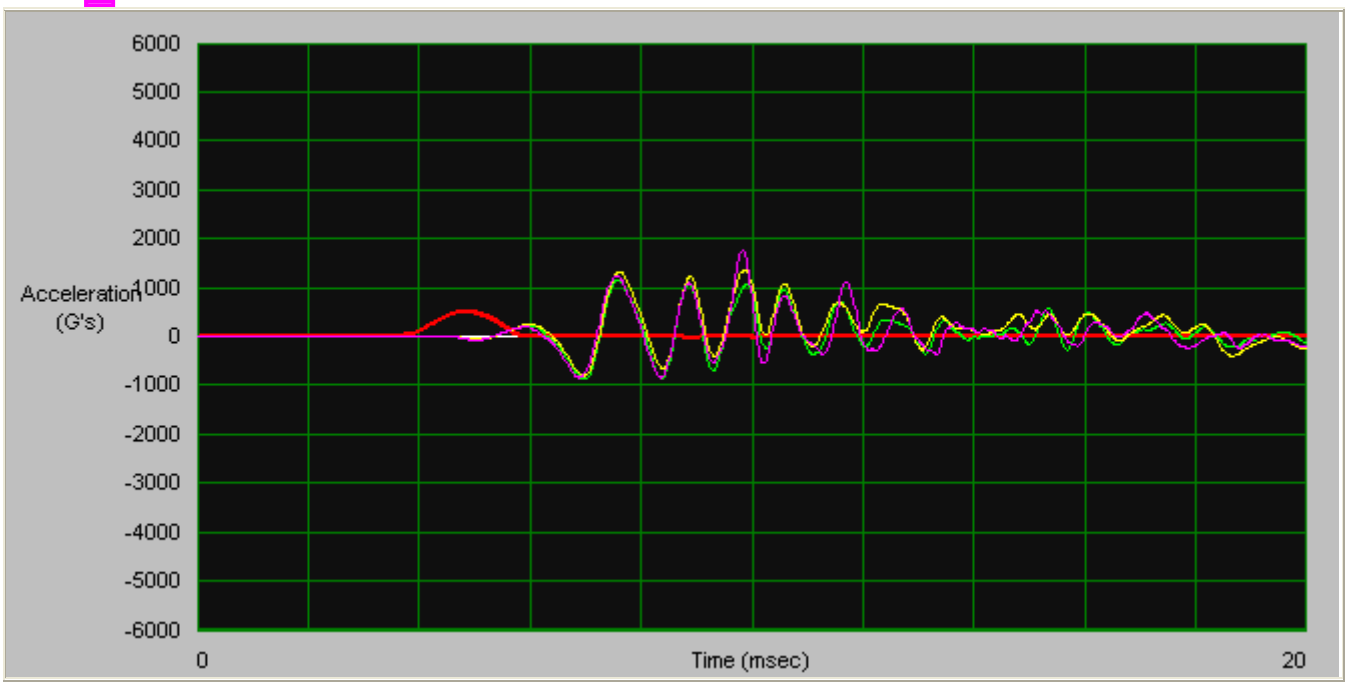
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	805.58	372.14	-679.63	317.48	-	-	-	-
SRS2	Composite	0.05	4936.46	823.44	-4066.22	1007.94	-	-	-	-
SRS3	Composite	0.05	5121.27	823.44	-3733.18	1083.40	-	-	-	-
SRS4	Composite	0.05	5613.46	951.37	-5235.29	951.37	-	-	-	-



Card 59, 147, 188 – Drop 8

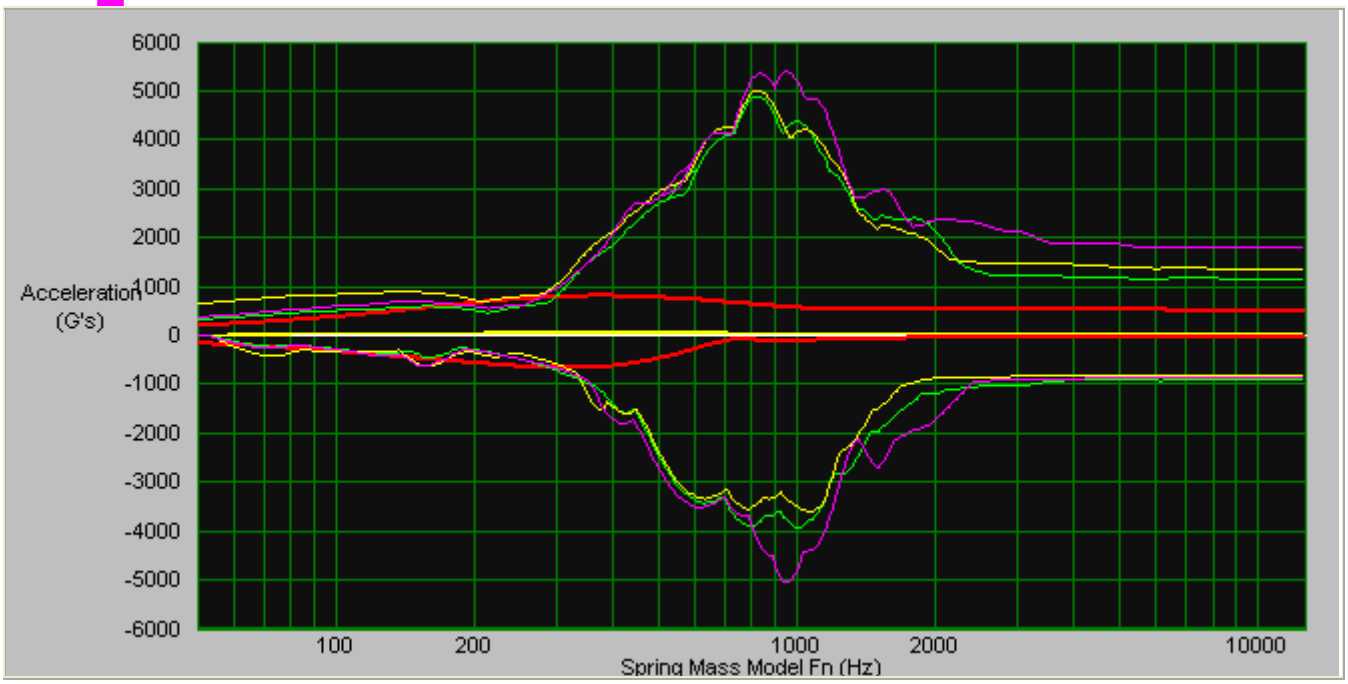
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	509.76	1.92	239.56	1302.08	509.76	-28.10
Ch2	147	1154.76	0.80	221.94	3205.13	1154.76	-876.85
Ch3	59	1359.88	0.70	228.01	1760.56	1359.88	-801.73
Ch4	188	1764.44	0.54	221.63	4310.34	1764.44	-842.00



Shock Response Spectra

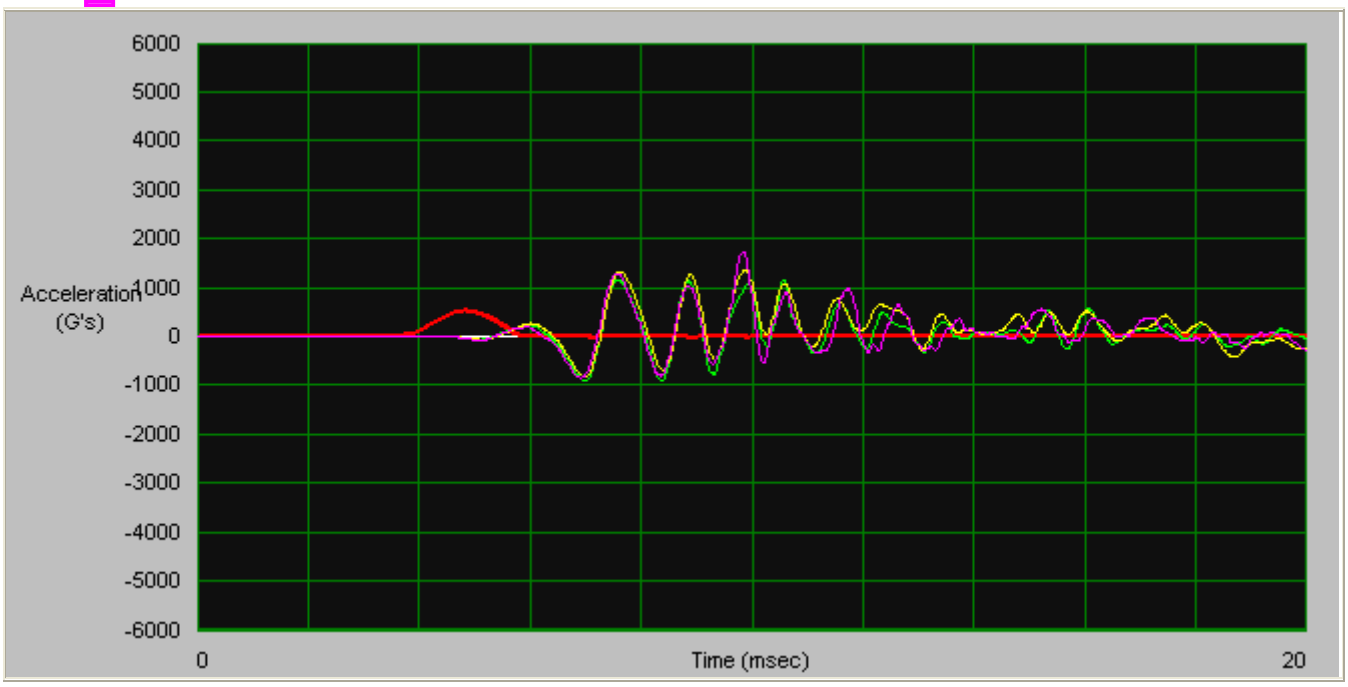
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	800.90	377.55	-667.24	322.10	-	-	-	-
SRS2	Composite	0.05	4881.98	823.44	-3936.07	1007.94	-	-	-	-
SRS3	Composite	0.05	5015.24	823.44	-3603.55	1067.87	-	-	-	-
SRS4	Composite	0.05	5394.16	951.37	-5056.42	951.37	-	-	-	-



Card 59, 147, 188 – Drop 9

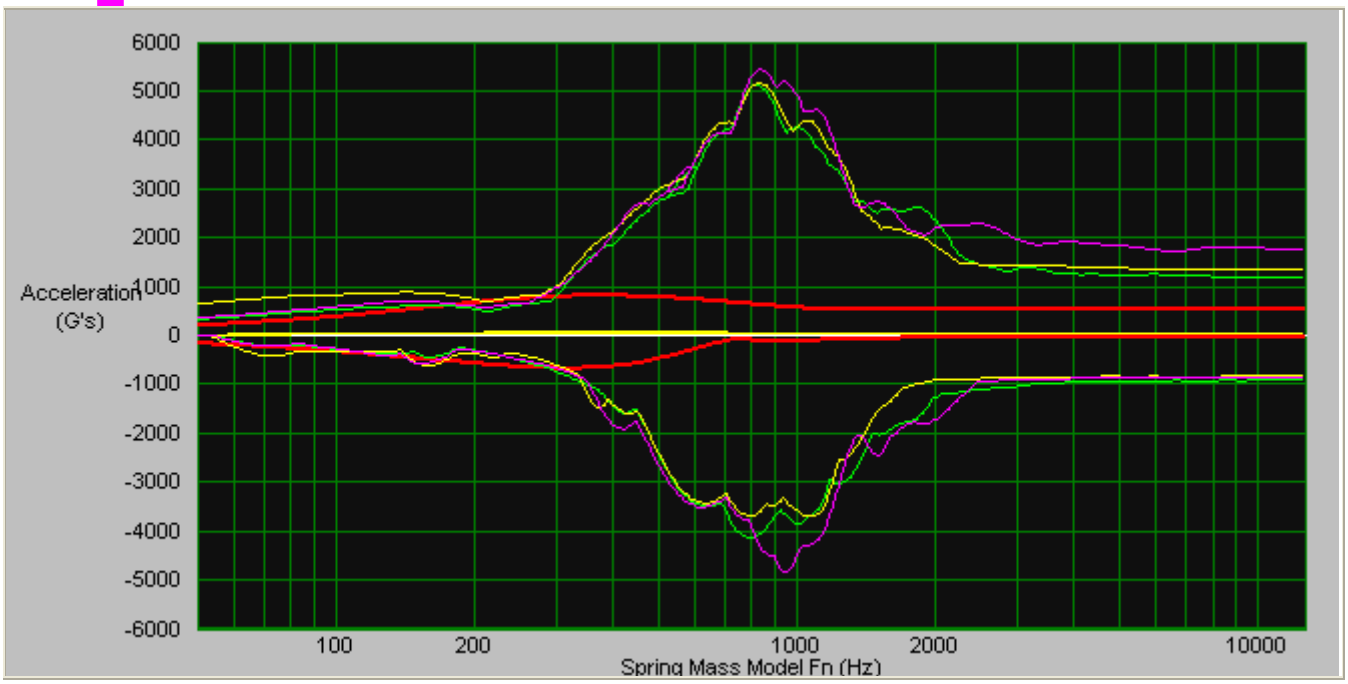
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	513.46	1.92	241.66	1302.08	513.46	-21.77
Ch2	147	1160.85	0.78	221.31	3205.13	1160.85	-902.63
Ch3	59	1351.78	0.68	228.99	1760.56	1351.78	-827.79
Ch4	188	1727.41	0.54	221.01	4310.34	1727.41	-846.25



Shock Response Spectra

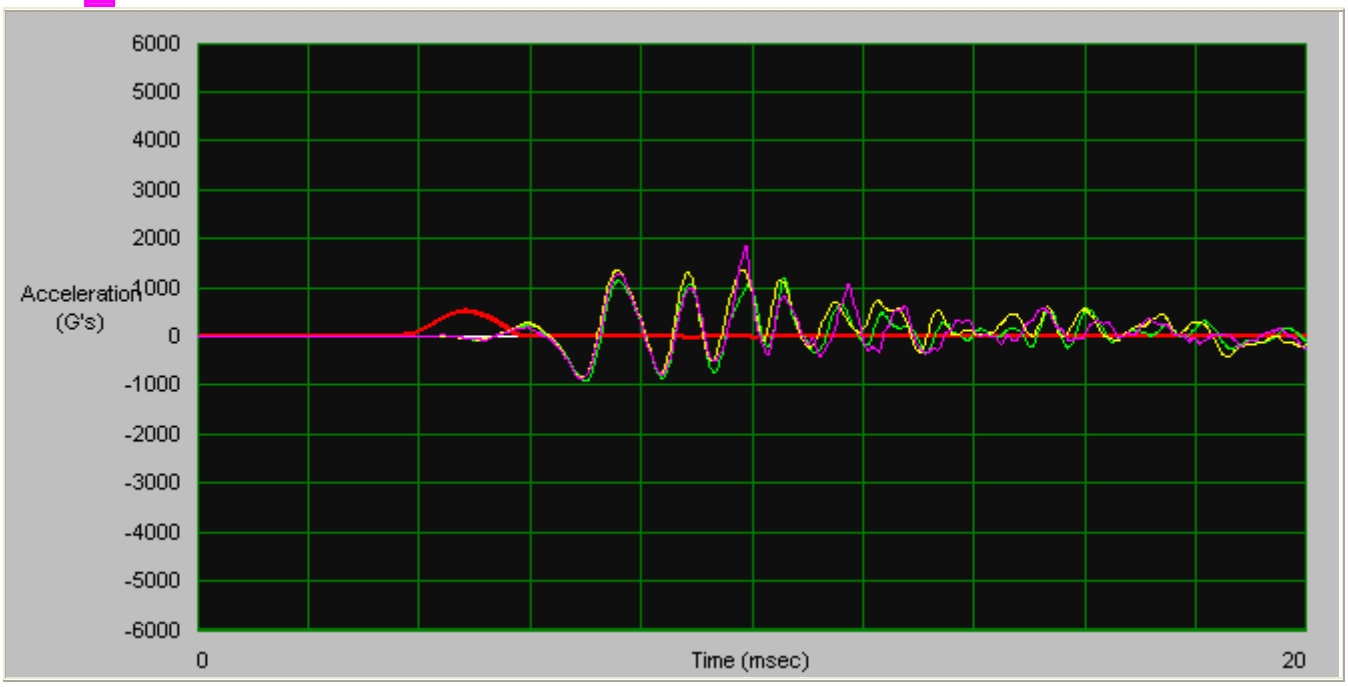
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	808.36	377.55	-678.04	322.10	-	-	-	-
SRS2	Composite	0.05	5110.53	823.44	-4151.52	800.00	-	-	-	-
SRS3	Composite	0.05	5153.70	835.42	-3706.30	1067.87	-	-	-	-
SRS4	Composite	0.05	5428.53	835.42	-4842.72	937.73	-	-	-	-



Card 59, 147, 188 – Drop 10

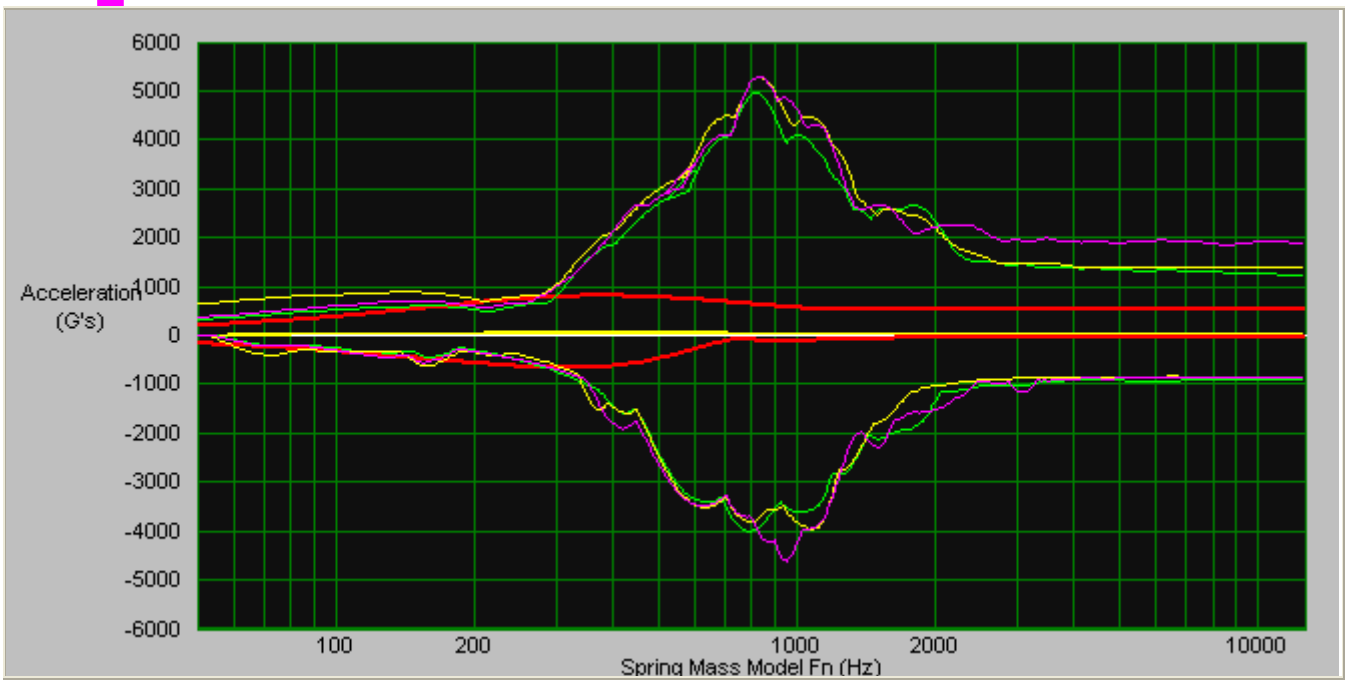
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	512.93	1.92	240.10	1315.79	512.93	-25.94
Ch2	147	1194.49	0.48	117.05	3205.13	1194.49	-899.14
Ch3	59	1370.12	0.68	227.44	2976.19	1370.12	-837.97
Ch4	188	1837.87	0.54	212.90	4166.67	1837.87	-865.24



Shock Response Spectra

	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	803.81	372.14	-669.84	322.10	-	-	-	-
SRS2	Composite	0.05	4949.08	811.64	-4006.33	788.53	-	-	-	-
SRS3	Composite	0.05	5276.58	835.42	-3963.43	1083.40	-	-	-	-
SRS4	Composite	0.05	5282.74	823.44	-4621.74	951.37	-	-	-	-

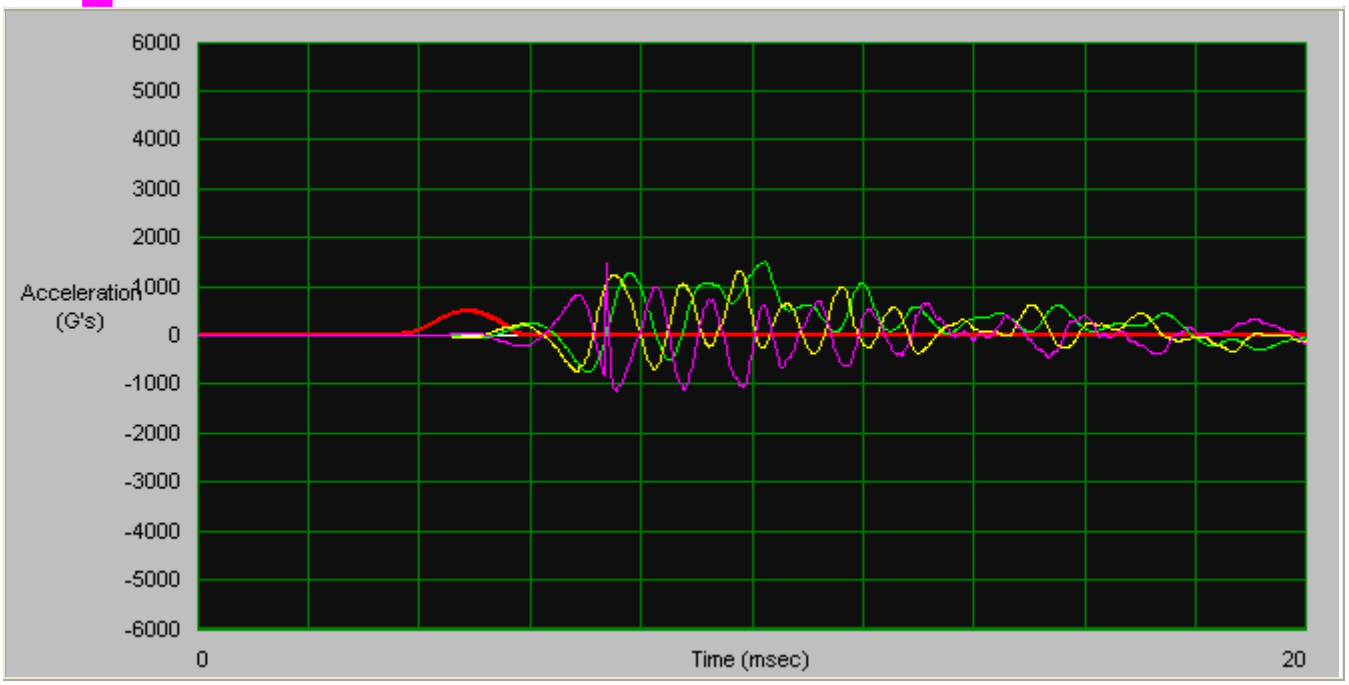


11.4 Set 4 – Card 28, 77, 145

Card 28, 77, 145 – Drop 1

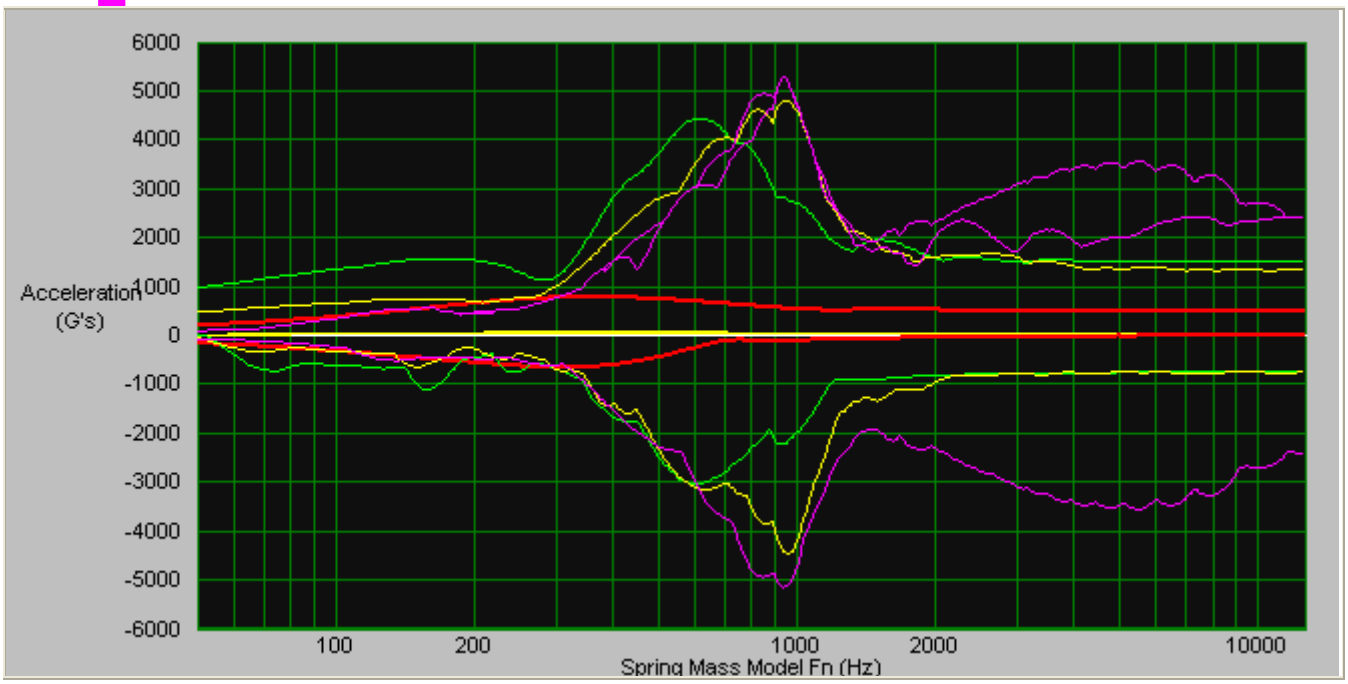
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	497.49	1.98	239.63	1275.51	497.49	-17.76
Ch2	145	1508.72	2.66	1649.00	946.97	1508.72	-746.33
Ch3	77	1325.35	0.66	198.37	2976.19	1325.35	-746.26
Ch4	28	1485.05	0.08	11.62	4464.29	1485.05	-1131.82



Shock Response Spectra

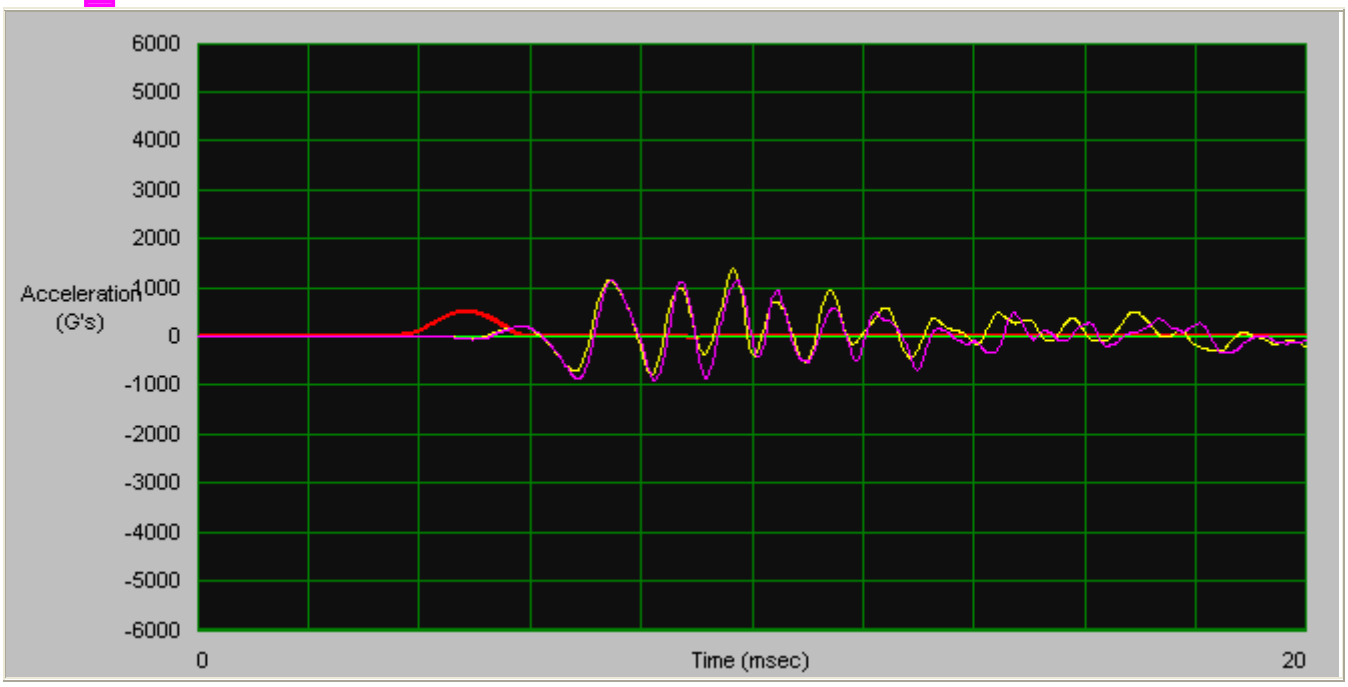
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	778.30	356.36	-656.63	312.93	-	-	-	-
SRS2	Composite	0.05	4441.18	616.88	-3039.14	608.04	-	-	-	-
SRS3	Composite	0.05	4810.93	951.37	-4480.88	951.37	-	-	-	-
SRS4	Composite	0.05	5273.83	937.73	-5149.30	937.73	-	-	-	-



Card 28, 77, 145 – Drop 2

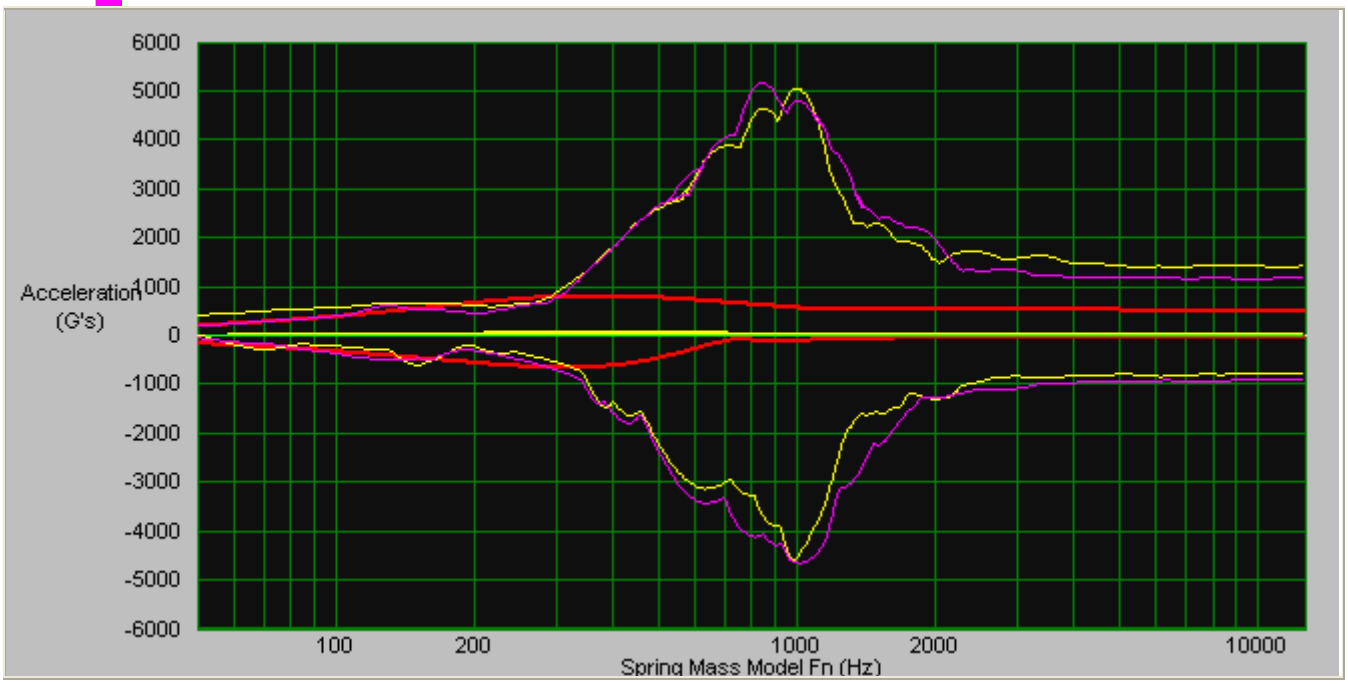
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	509.90	1.96	242.22	1275.51	509.90	-25.05
Ch2	145	6.96	20.00	45.45	125.00	6.96	4.88
Ch3	77	1383.42	0.60	191.81	3906.25	1383.42	-774.90
Ch4	28	1155.00	0.58	165.11	3205.13	1155.00	-896.85



Shock Response Spectra

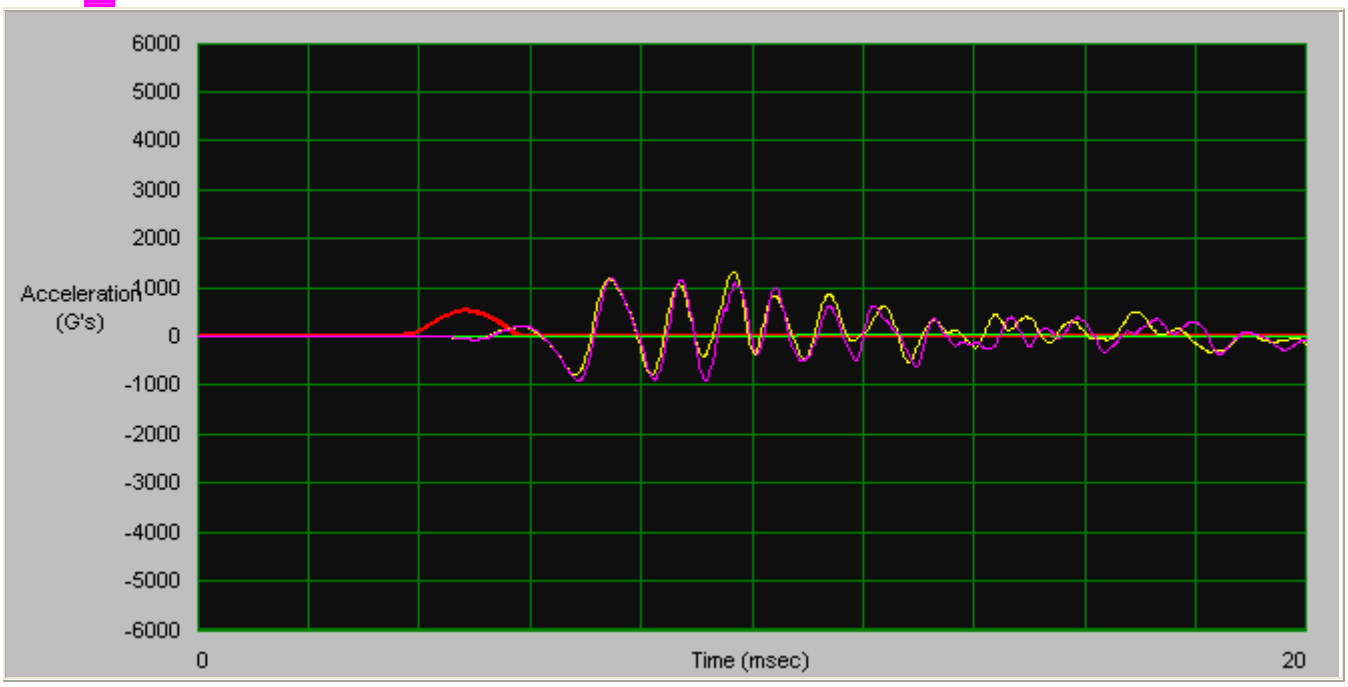
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	797.26	366.80	-661.68	312.93	-	-	-	-
SRS2	Composite	0.05	11.74	104.43	0.00	49.28	-	-	-	-
SRS3	Composite	0.05	5048.03	1007.94	-4594.09	979.24	-	-	-	-
SRS4	Composite	0.05	5151.41	847.57	-4668.61	1022.60	-	-	-	-



Card 28, 77, 145 – Drop 3

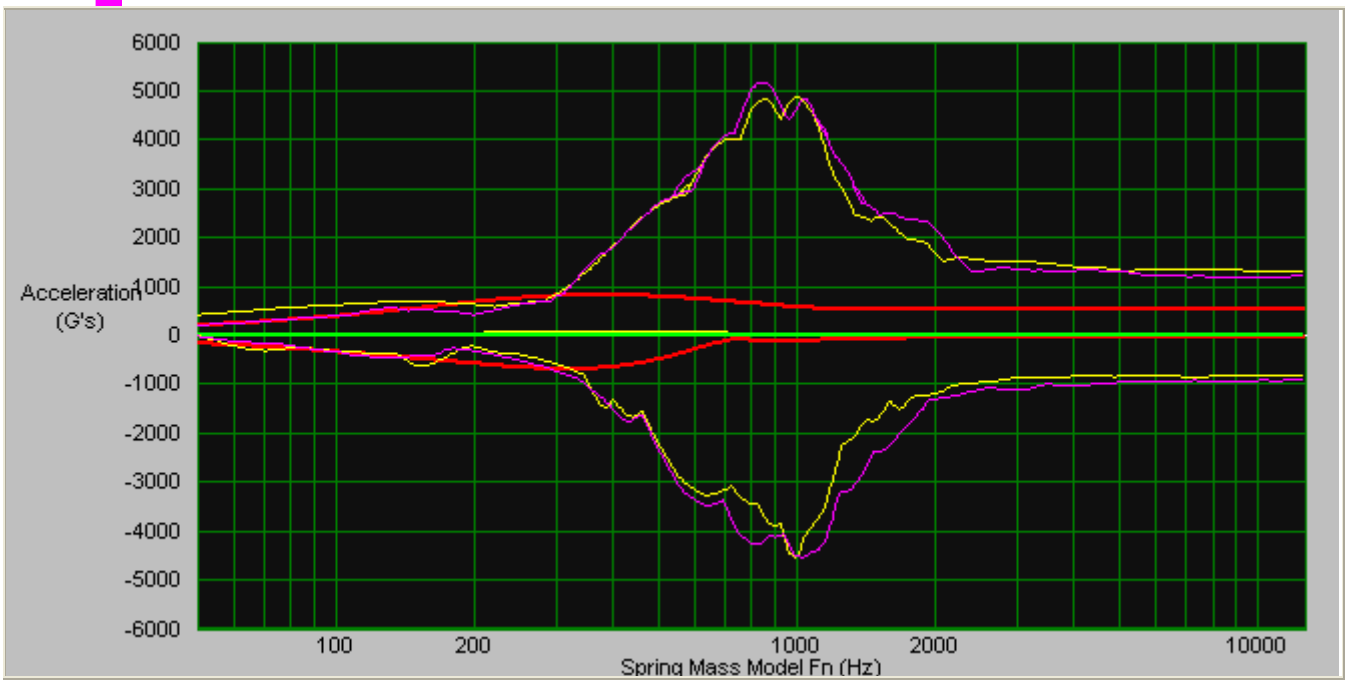
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	521.45	1.92	246.04	1302.08	521.45	-20.36
Ch2	145	21.78	20.00	111.12	125.00	21.78	4.88
Ch3	77	1313.69	0.60	195.43	3906.25	1313.69	-795.28
Ch4	28	1193.19	0.76	217.18	3289.47	1193.19	-911.89



Shock Response Spectra

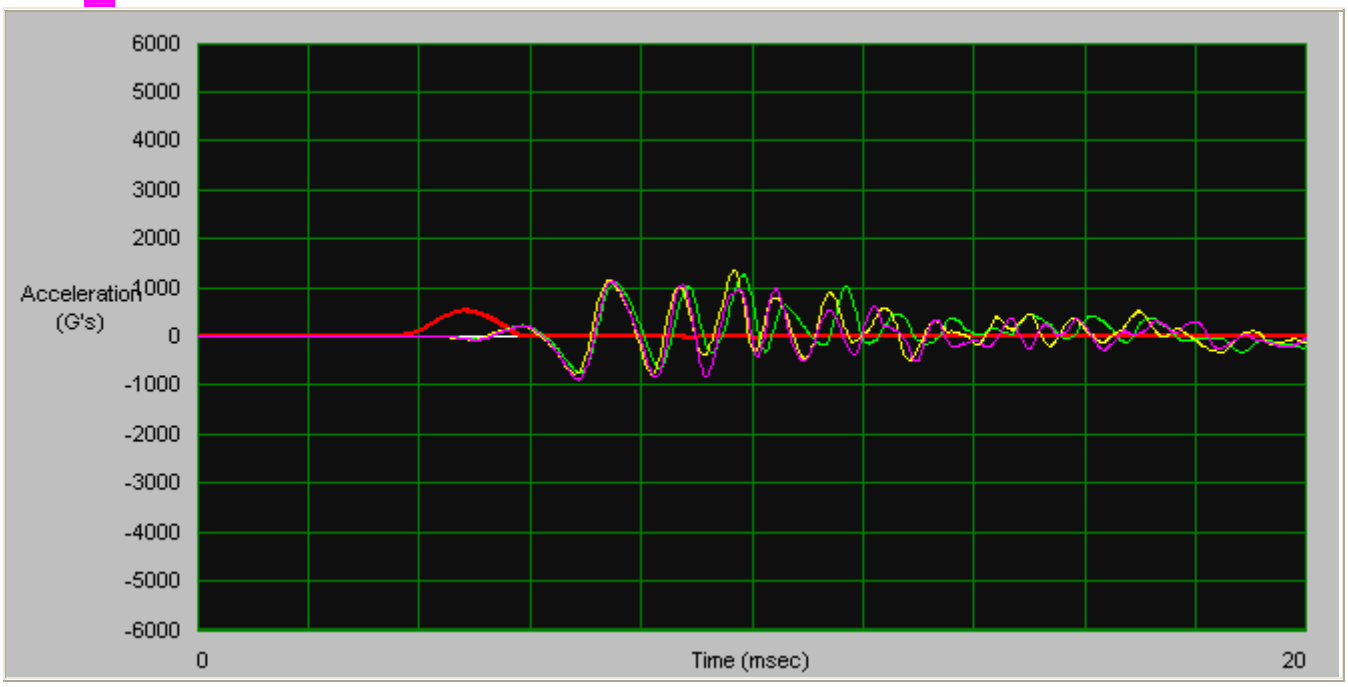
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	822.15	372.14	-689.88	322.10	-	-	-	-
SRS2	Composite	0.05	35.36	100.00	0.00	49.28	-	-	-	-
SRS3	Composite	0.05	4857.14	1007.94	-4533.89	993.49	-	-	-	-
SRS4	Composite	0.05	5171.75	847.57	-4556.31	1037.47	-	-	-	-



Card 28, 77, 145 – Drop 4

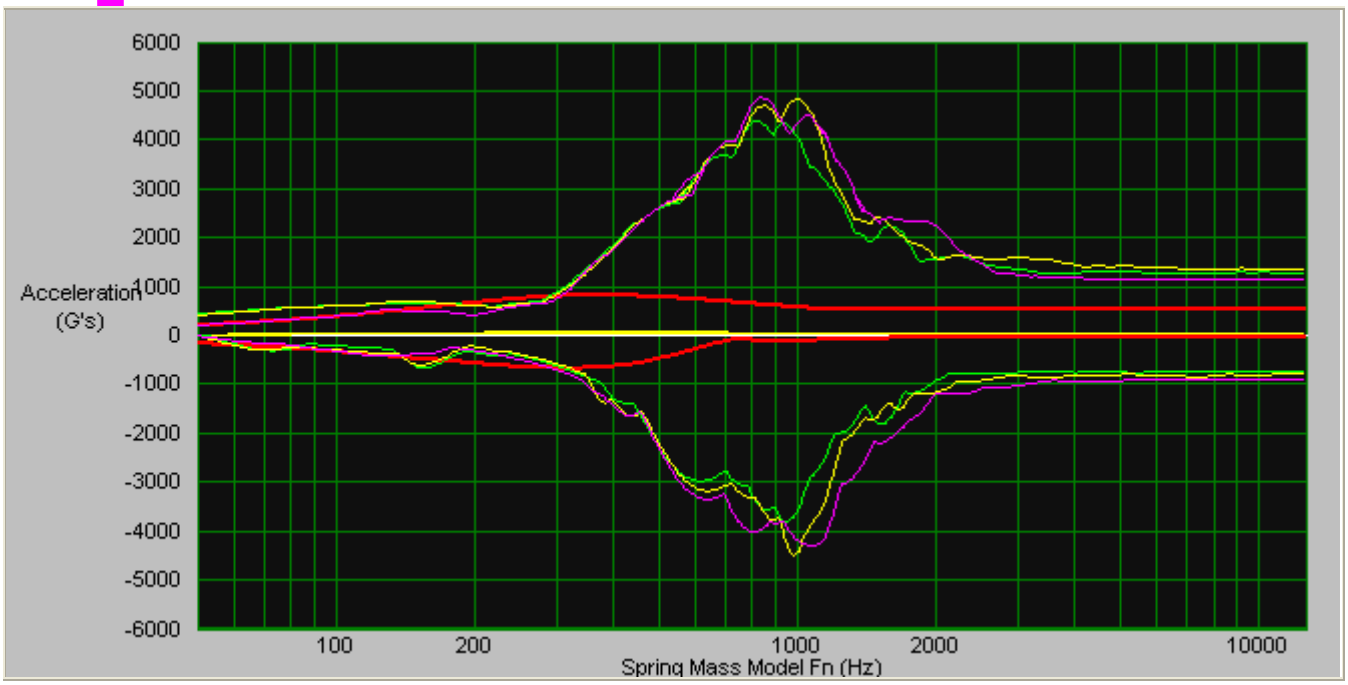
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	517.10	1.92	243.85	1302.08	517.10	-23.98
Ch2	145	1262.02	0.62	191.47	3676.47	1262.02	-723.96
Ch3	77	1356.02	0.62	192.35	3906.25	1356.02	-775.07
Ch4	28	1127.22	0.76	211.06	3205.13	1127.22	-880.93



Shock Response Spectra

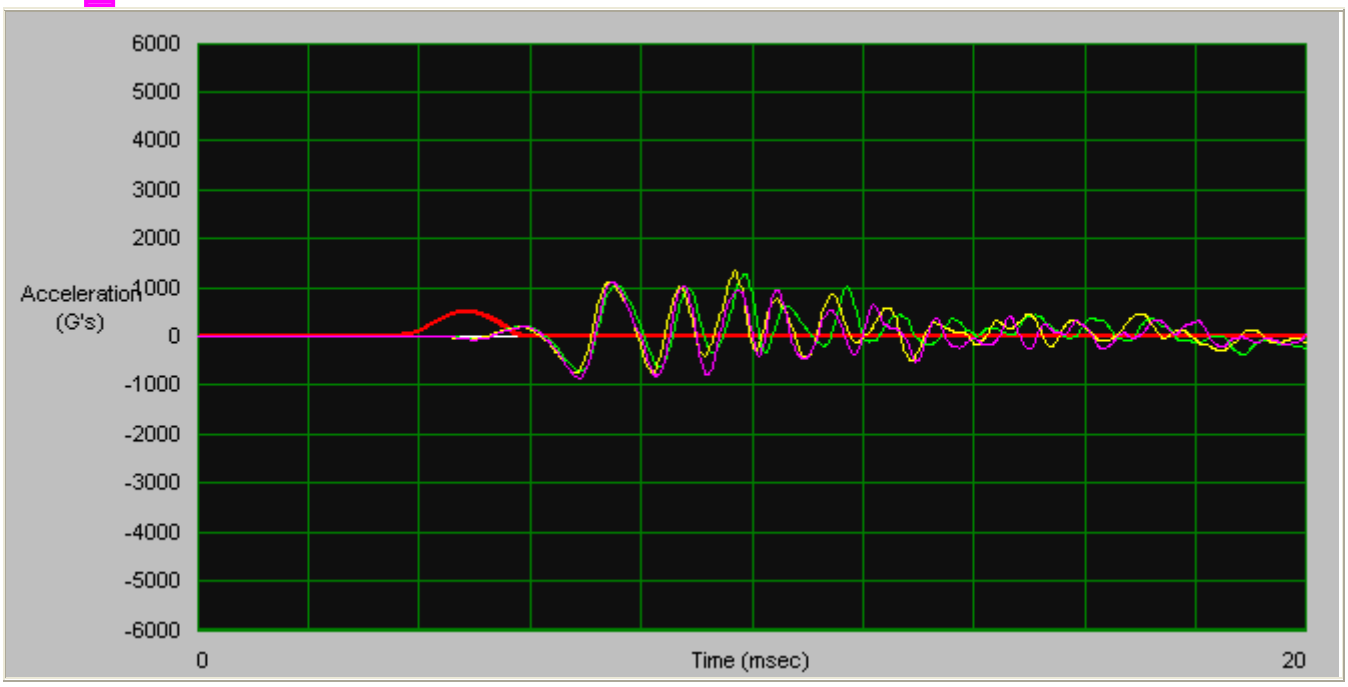
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	812.34	366.80	-678.15	317.48	-	-	-	-
SRS2	Composite	0.05	4367.08	823.44	-3804.51	951.37	-	-	-	-
SRS3	Composite	0.05	4826.86	993.49	-4499.85	979.24	-	-	-	-
SRS4	Composite	0.05	4856.67	835.42	-4309.72	1083.40	-	-	-	-



Card 28, 77, 145 – Drop 5

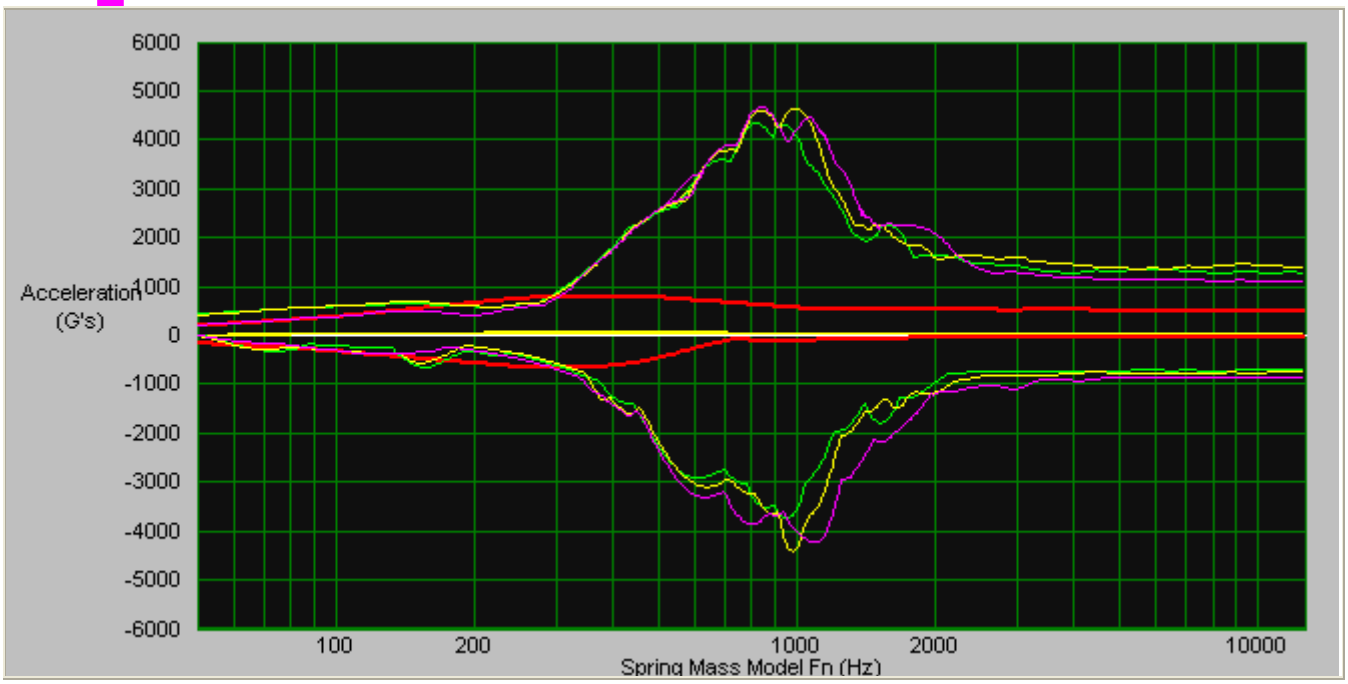
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	508.30	1.94	243.22	1275.51	508.30	-20.20
Ch2	145	1279.29	0.60	188.69	3906.25	1279.29	-707.87
Ch3	77	1353.99	0.62	190.55	3787.88	1353.99	-748.56
Ch4	28	1117.26	0.78	208.67	3205.13	1117.26	-850.60



Shock Response Spectra

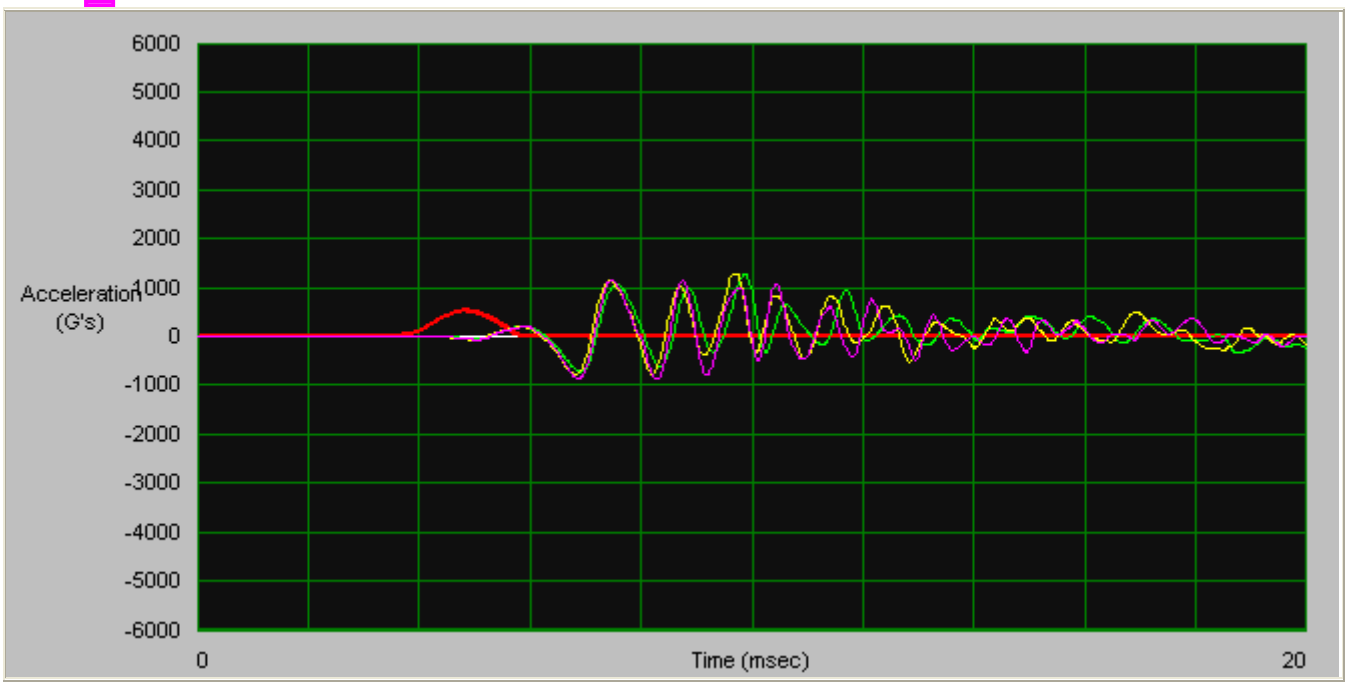
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	797.54	356.36	-675.30	312.93	-	-	-	-
SRS2	Composite	0.05	4332.51	811.64	-3743.44	951.37	-	-	-	-
SRS3	Composite	0.05	4638.60	993.49	-4419.04	979.24	-	-	-	-
SRS4	Composite	0.05	4659.26	835.42	-4234.04	1099.16	-	-	-	-



Card 28, 77, 145 – Drop 6

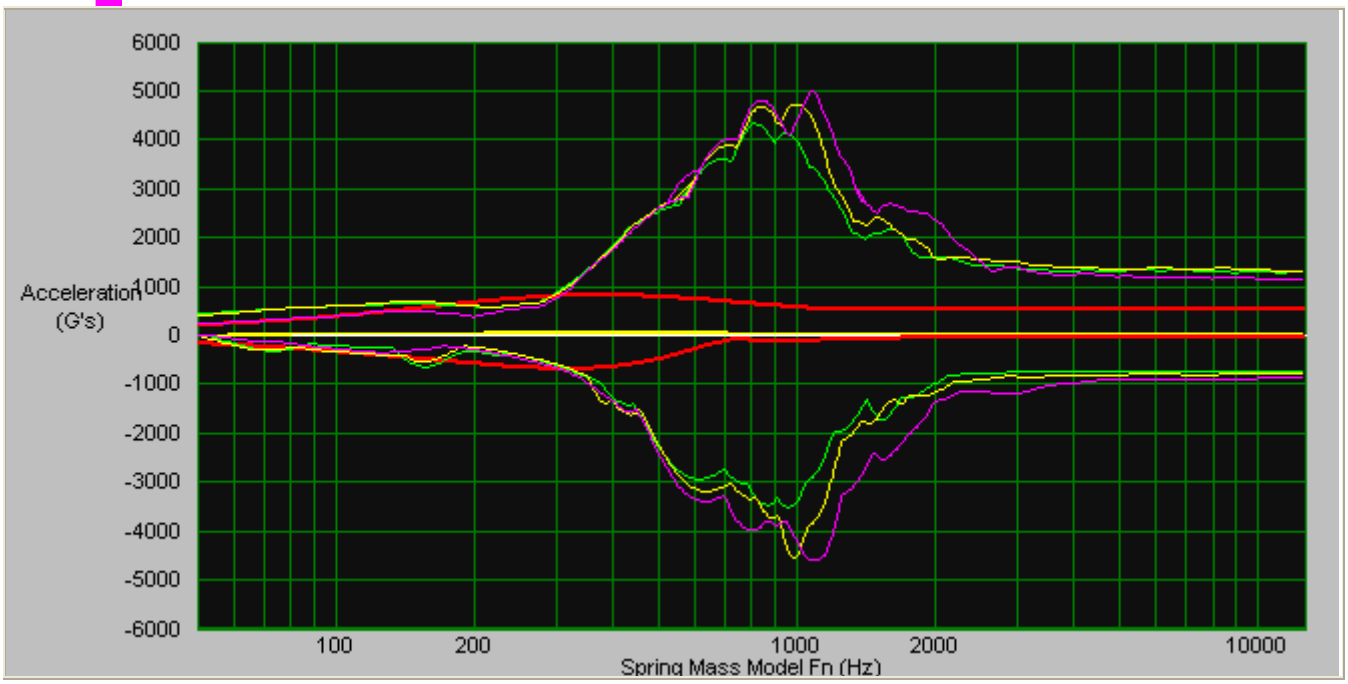
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	519.43	1.94	245.18	1302.08	519.43	-20.84
Ch2	145	1279.24	0.62	188.39	3906.25	1279.24	-716.92
Ch3	77	1283.70	0.62	190.27	3787.88	1283.70	-777.27
Ch4	28	1160.03	0.78	212.80	3205.13	1160.03	-877.73



Shock Response Spectra

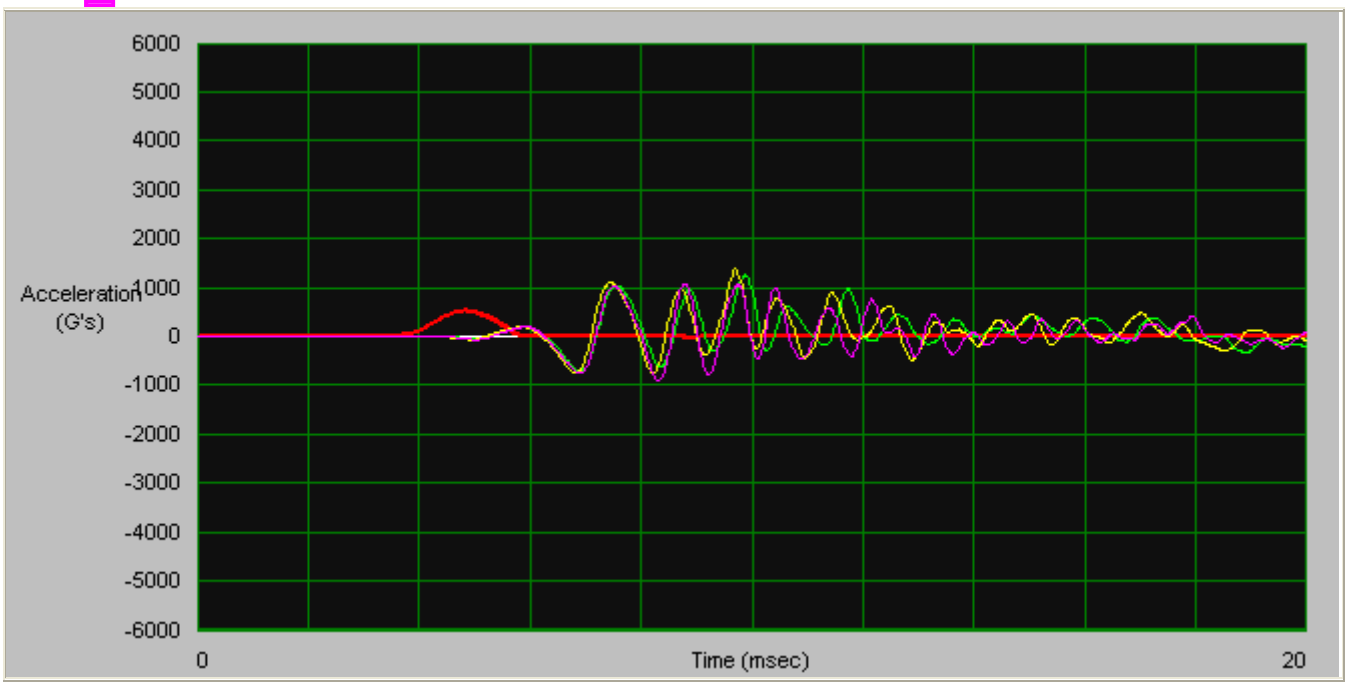
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	815.52	372.14	-686.60	317.48	-	-	-	-
SRS2	Composite	0.05	4321.88	811.64	-3522.34	951.37	-	-	-	-
SRS3	Composite	0.05	4723.12	993.49	-4546.72	979.24	-	-	-	-
SRS4	Composite	0.05	4980.98	1083.40	-4599.08	1099.16	-	-	-	-



Card 28, 77, 145 – Drop 7

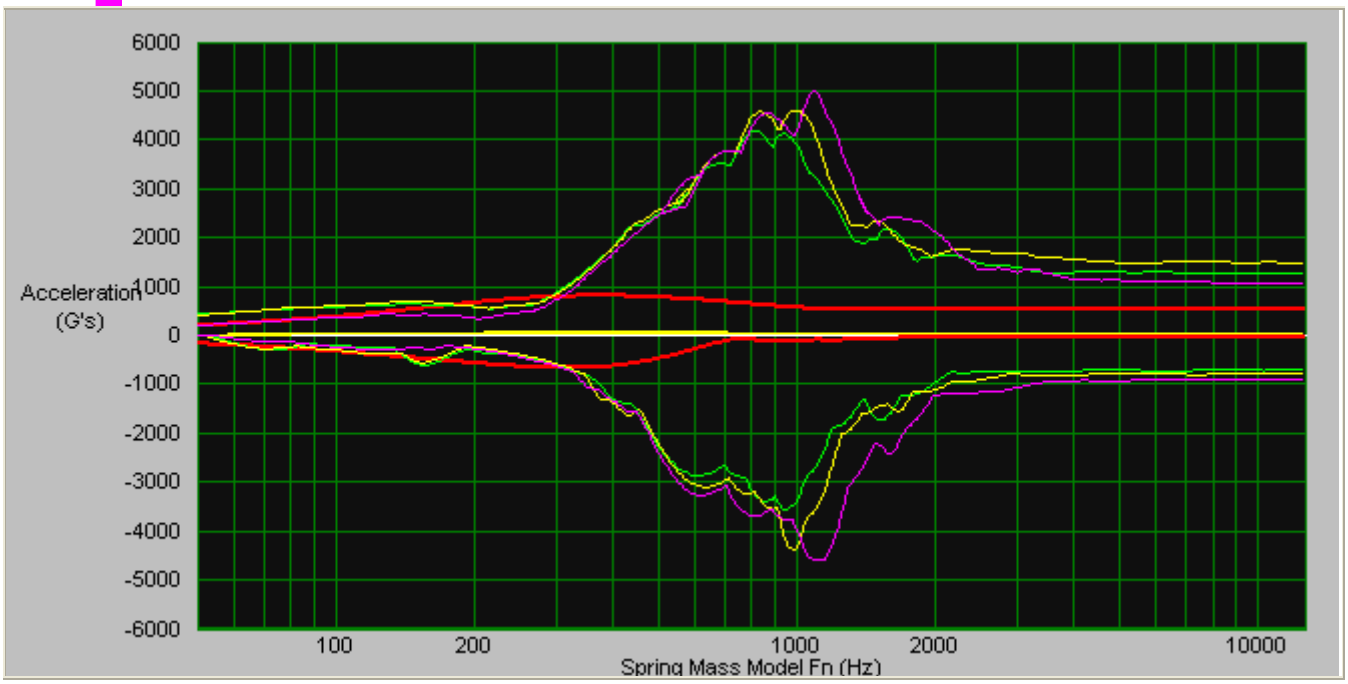
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	513.96	1.94	242.13	1302.08	513.96	-27.48
Ch2	145	1250.27	0.62	186.35	3787.88	1250.27	-703.97
Ch3	77	1396.65	0.60	187.14	3906.25	1396.65	-758.33
Ch4	28	1069.71	0.46	123.96	3125.00	1069.71	-892.74



Shock Response Spectra

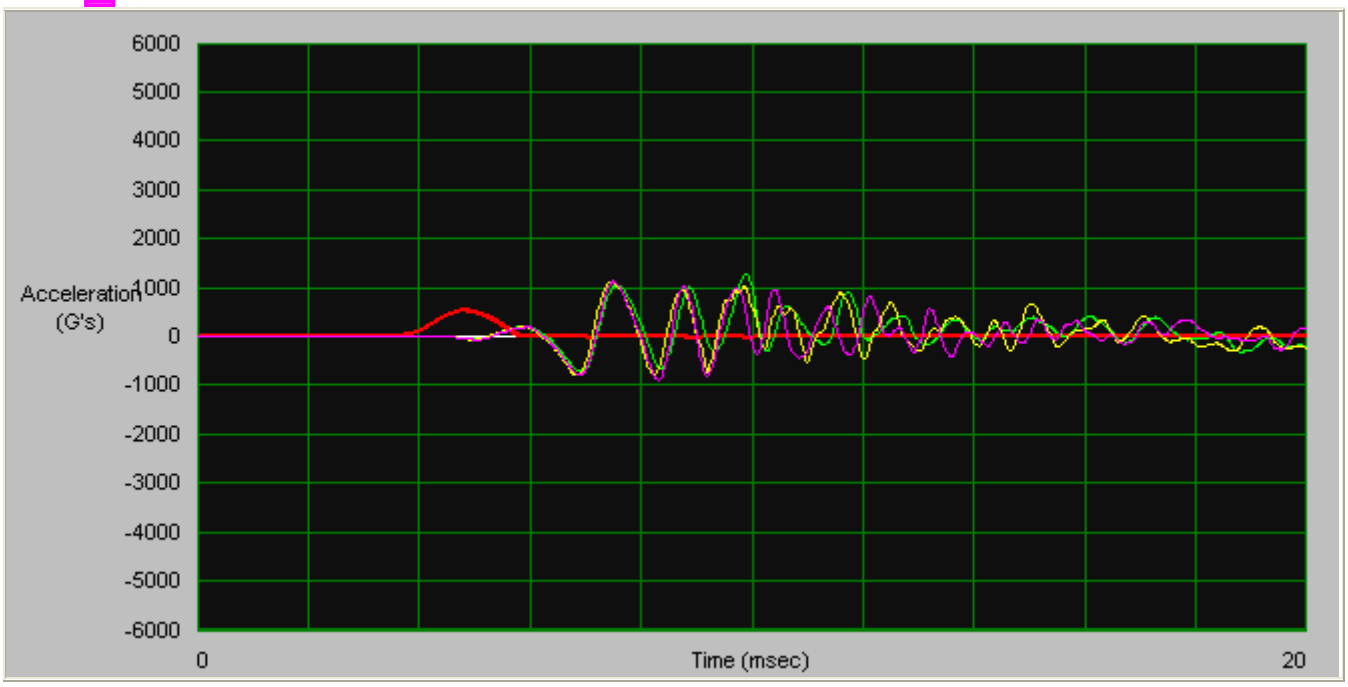
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	805.26	377.55	-668.70	317.48	-	-	-	-
SRS2	Composite	0.05	4178.19	811.64	-3552.10	951.37	-	-	-	-
SRS3	Composite	0.05	4604.07	993.49	-4401.61	979.24	-	-	-	-
SRS4	Composite	0.05	4996.94	1099.16	-4598.03	1131.37	-	-	-	-



Card 28, 77, 145 – Drop 8

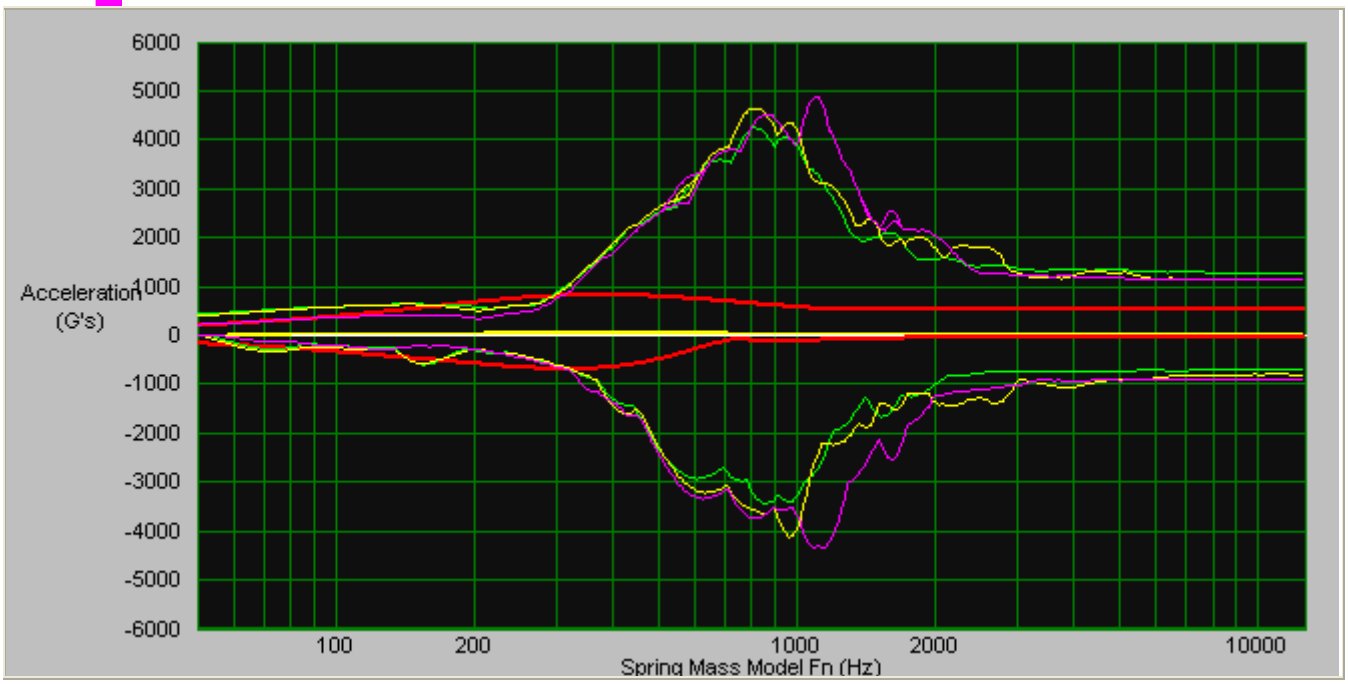
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	521.57	1.90	244.60	1302.08	521.57	-26.37
Ch2	145	1268.27	0.60	186.27	3787.88	1268.27	-710.27
Ch3	77	1124.41	0.80	231.07	3048.78	1124.41	-794.42
Ch4	28	1126.56	0.78	206.53	3289.47	1126.56	-887.90



Shock Response Spectra

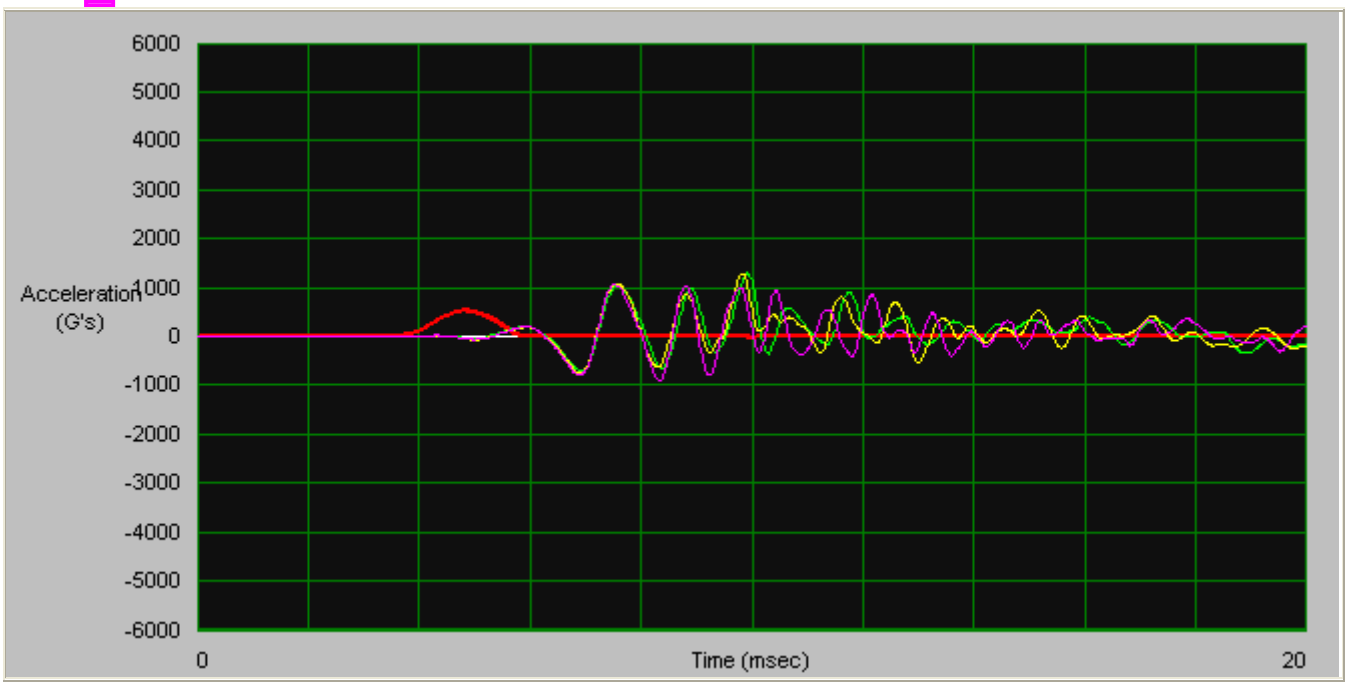
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	819.75	372.14	-688.95	322.10	-	-	-	-
SRS2	Composite	0.05	4241.42	811.64	-3430.19	859.90	-	-	-	-
SRS3	Composite	0.05	4648.42	811.64	-4122.25	965.20	-	-	-	-
SRS4	Composite	0.05	4882.65	1099.16	-4338.83	1099.16	-	-	-	-



Card 28, 77, 145 – Drop 9

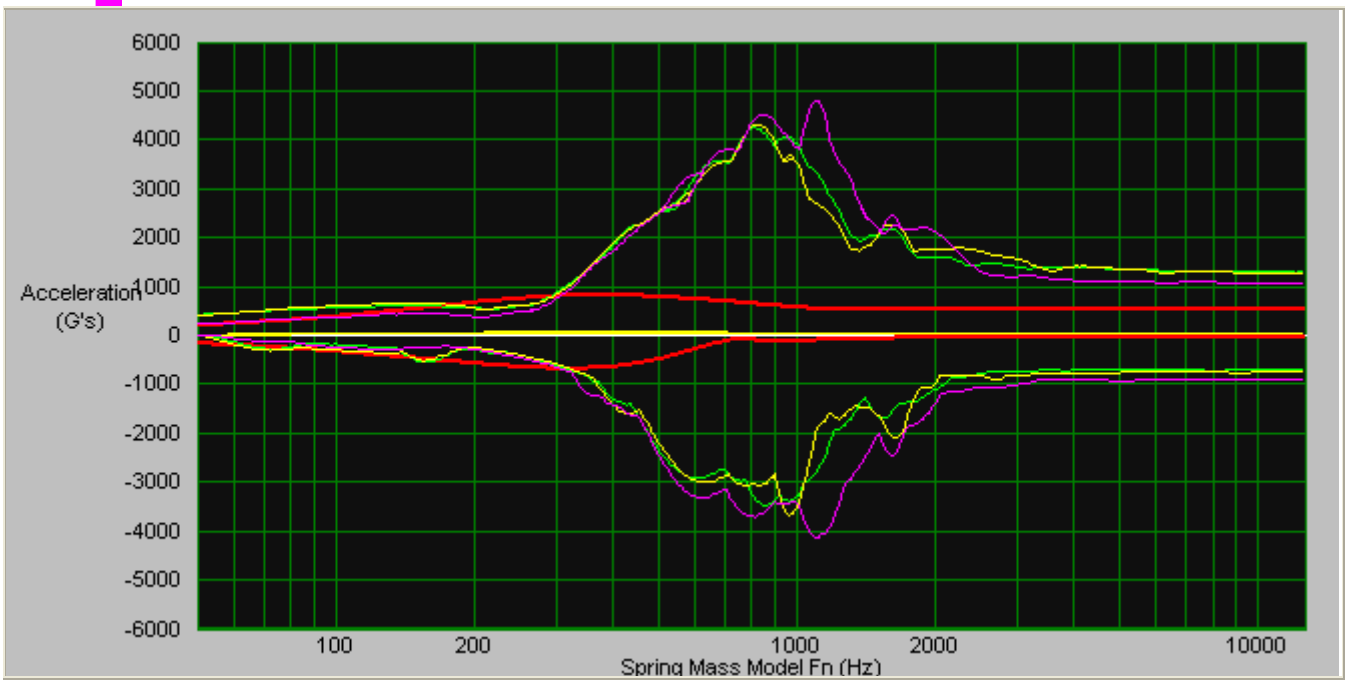
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	518.82	1.92	243.89	1302.08	518.82	-23.39
Ch2	145	1290.90	0.60	185.93	3906.25	1290.90	-703.50
Ch3	77	1271.44	0.58	274.05	1666.67	1271.44	-750.66
Ch4	28	1071.74	0.78	204.88	3205.13	1071.74	-896.36



Shock Response Spectra

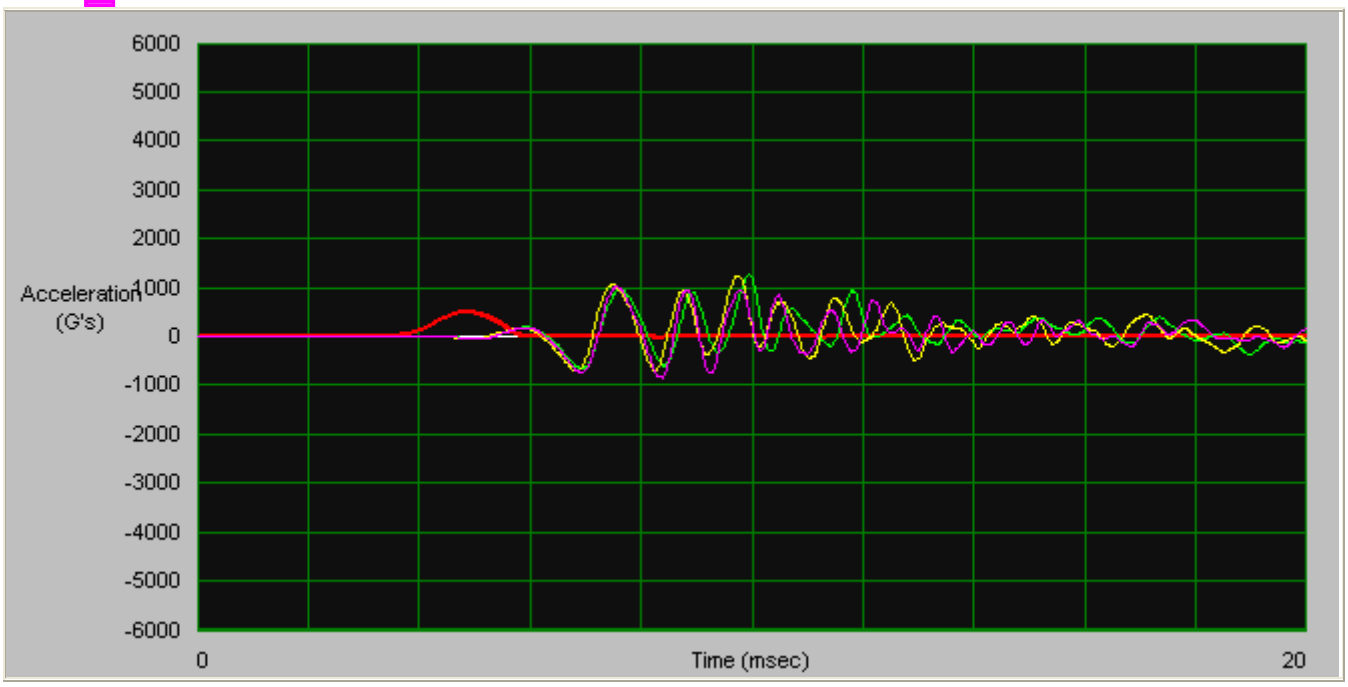
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	815.15	372.14	-680.97	317.48	-	-	-	-
SRS2	Composite	0.05	4242.91	811.64	-3469.47	859.90	-	-	-	-
SRS3	Composite	0.05	4303.50	823.44	-3678.82	965.20	-	-	-	-
SRS4	Composite	0.05	4808.80	1099.16	-4146.32	1099.16	-	-	-	-



Card 28, 77, 145 – Drop 10

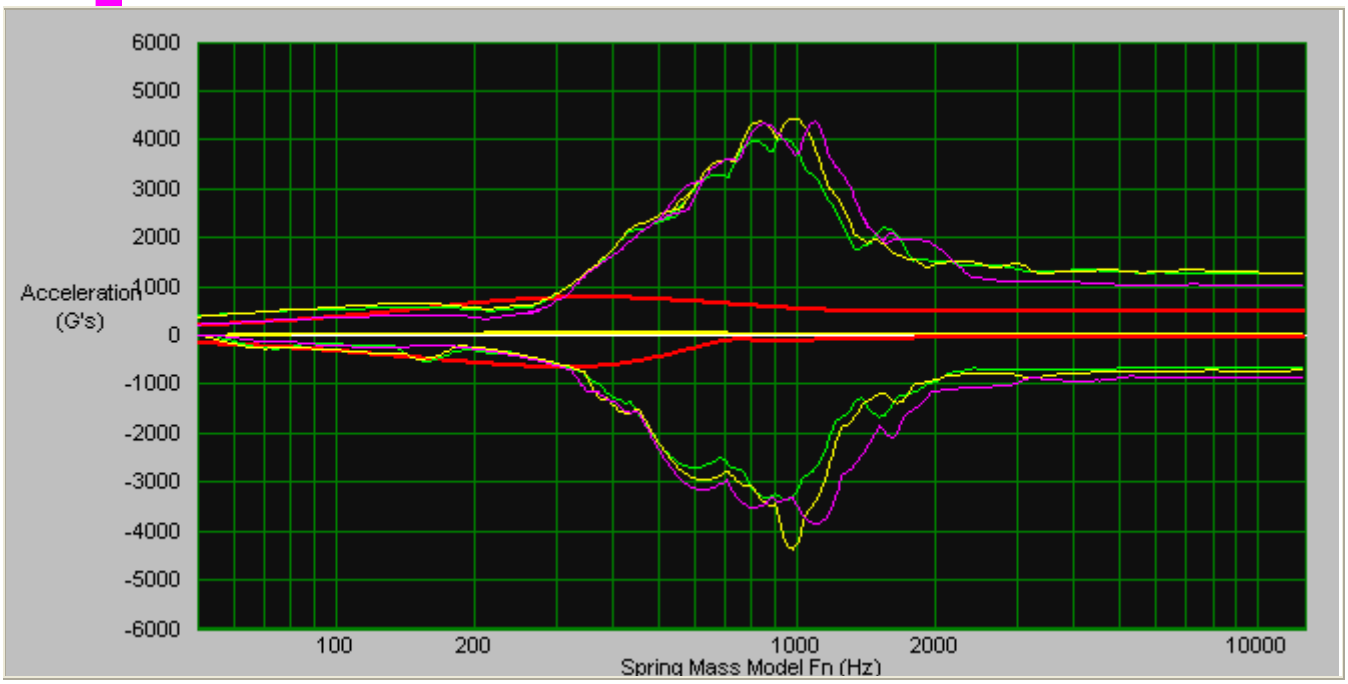
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	494.01	2.00	240.00	1250.00	494.01	-22.87
Ch2	145	1257.73	0.60	180.43	3906.25	1257.73	-652.05
Ch3	77	1234.34	0.62	186.26	3787.88	1234.34	-708.30
Ch4	28	1012.99	0.78	193.34	3289.47	1012.99	-844.99



Shock Response Spectra

	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	773.94	366.80	-653.68	312.93	-	-	-	-
SRS2	Composite	0.05	4024.73	937.73	-3364.71	951.37	-	-	-	-
SRS3	Composite	0.05	4439.33	979.24	-4366.98	979.24	-	-	-	-
SRS4	Composite	0.05	4365.05	1099.16	-3847.92	1083.40	-	-	-	-

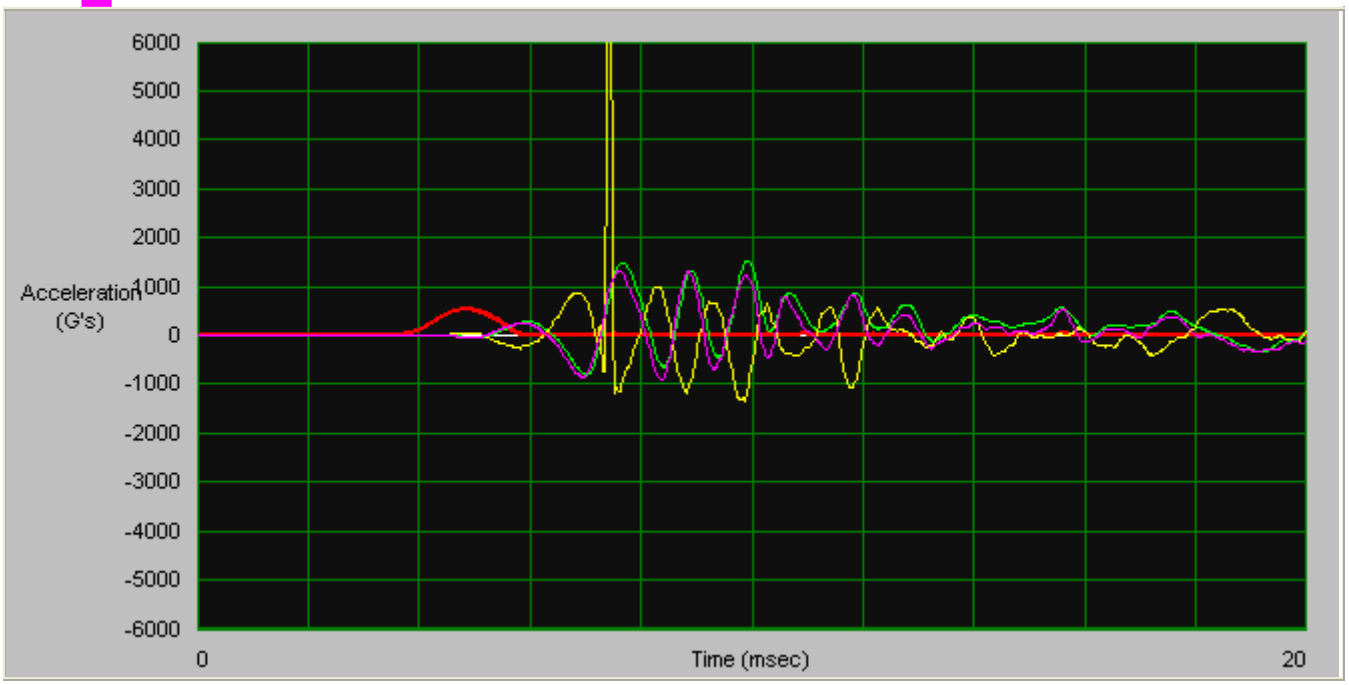


11.5 Set 5 – Card 25 (strain gauged), 92, 186

Card 25, 92, 186 – Drop 1

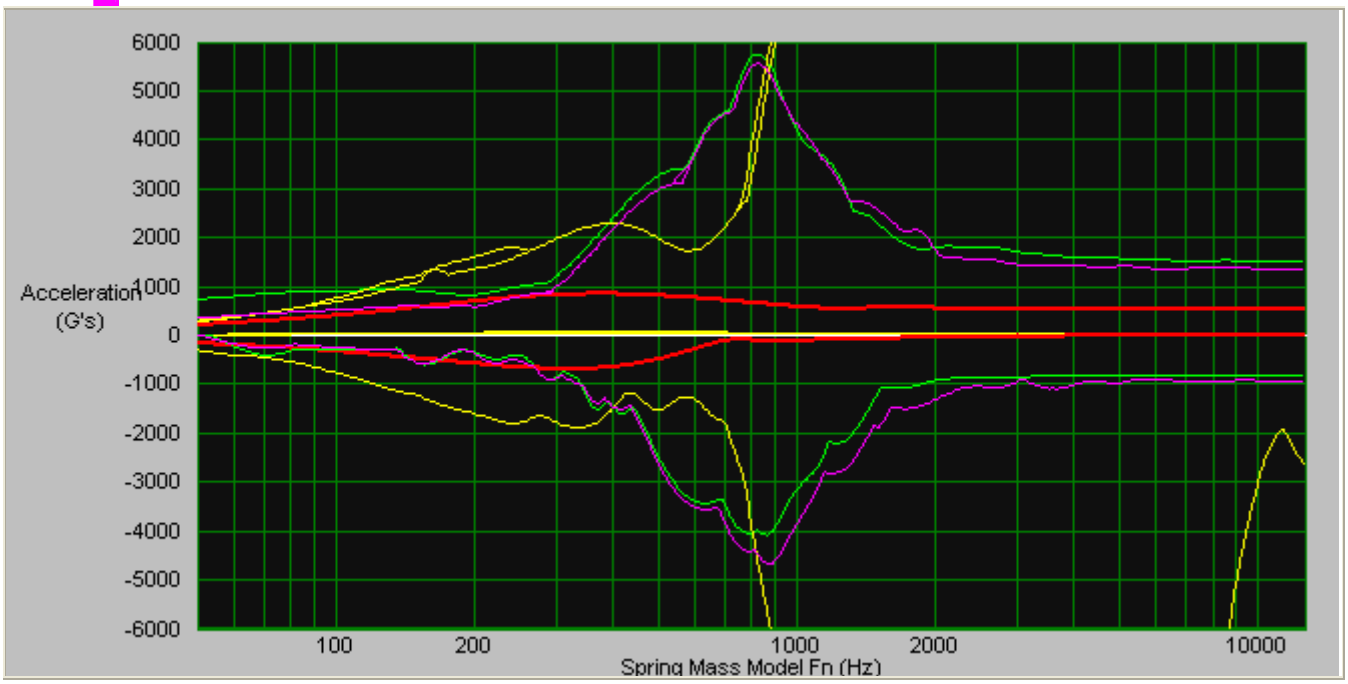
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	534.86	1.94	254.35	1288.66	534.86	-15.41
Ch2	25 (strain gauged)	1523.80	0.70	716.59	1582.28	1523.80	-803.73
Ch3	186	10044.61	0.14	348.26	6578.95	10044.61	-1365.36
Ch4	92	1324.39	0.78	256.92	3125.00	1324.39	-905.23



Shock Response Spectra

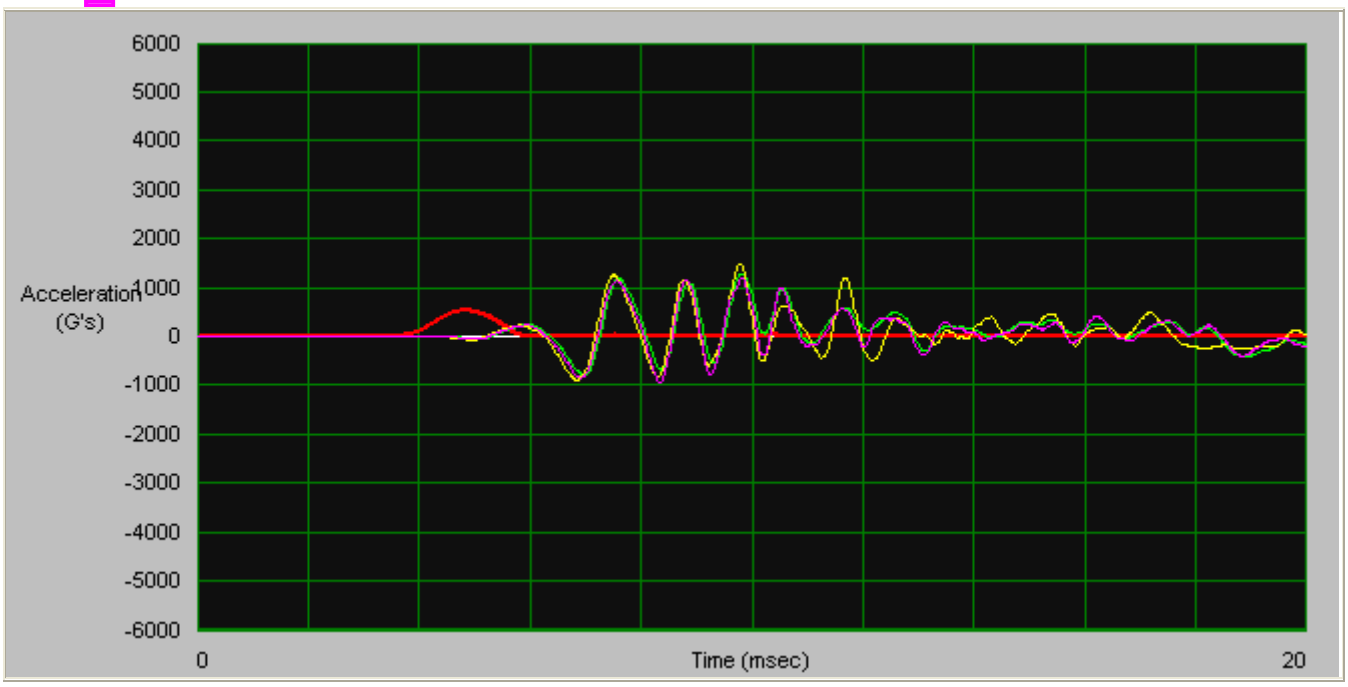
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	843.30	372.14	-689.42	322.10	-	-	-	-
SRS2	Composite	0.05	5736.94	823.44	-4082.53	859.90	-	-	-	-
SRS3	Composite	0.05	17596.60	5701.75	-16142.66	4658.09	-	-	-	-
SRS4	Composite	0.05	5556.42	823.44	-4672.31	872.41	-	-	-	-



Card 25, 92, 186 – Drop 2

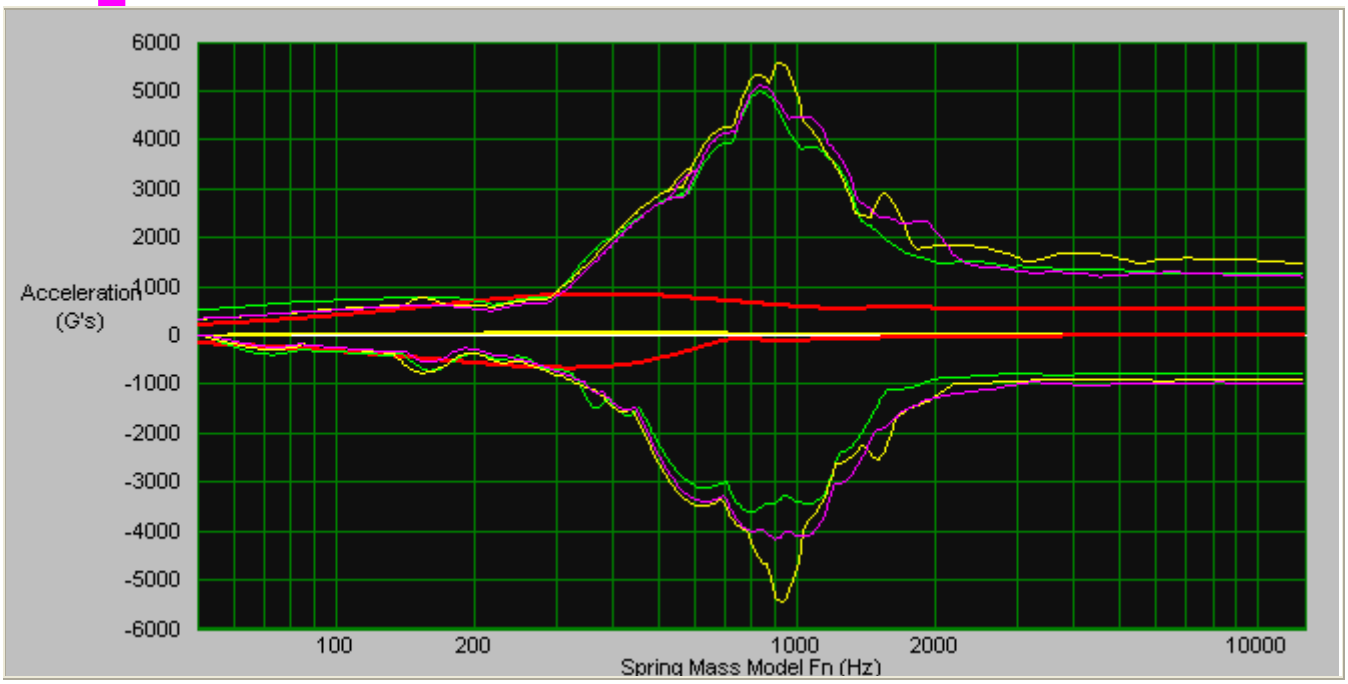
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	532.48	1.94	251.61	1288.66	532.48	-15.04
Ch2	25 (strain gauged)	1267.96	0.66	347.76	1785.71	1267.96	-777.39
Ch3	186	1483.07	0.56	197.41	4166.67	1483.07	-886.16
Ch4	92	1179.55	0.62	180.59	3125.00	1179.55	-941.70



Shock Response Spectra

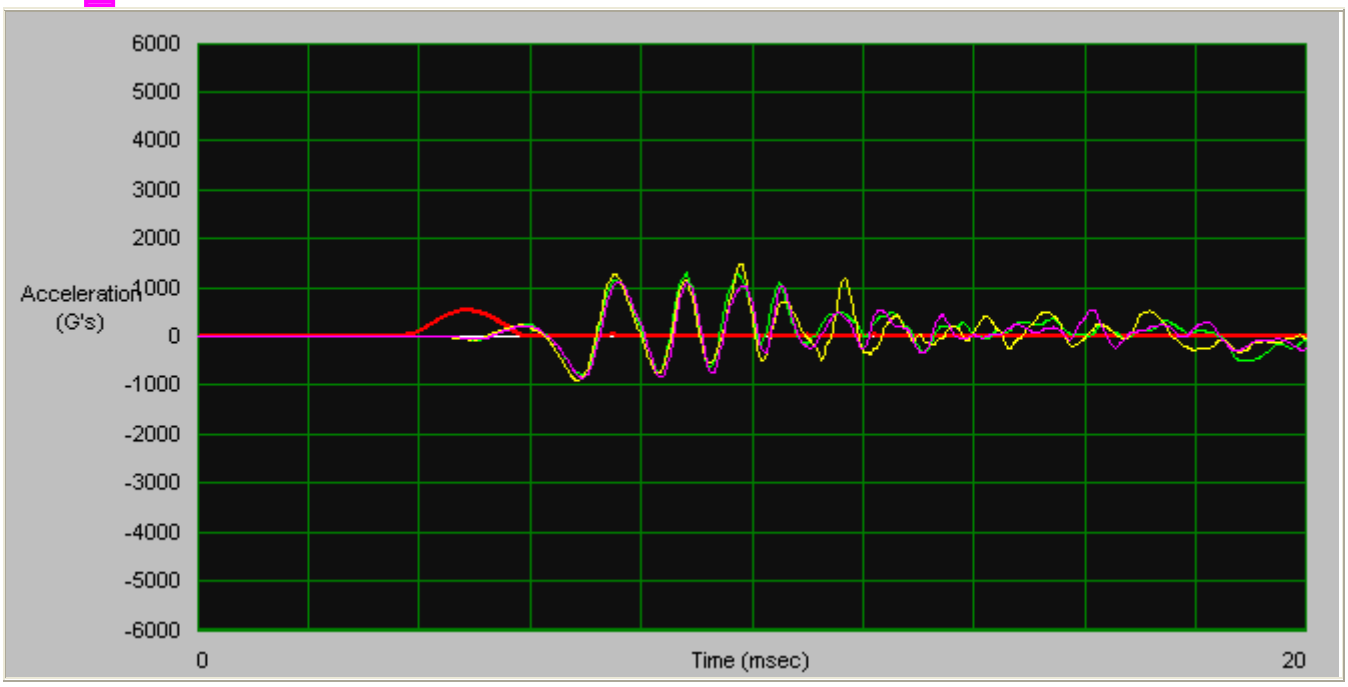
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	835.24	372.14	-676.56	322.10	-	-	-	-
SRS2	Composite	0.05	4977.95	835.42	-3611.89	800.00	-	-	-	-
SRS3	Composite	0.05	5582.74	924.28	-5456.32	924.28	-	-	-	-
SRS4	Composite	0.05	5099.70	835.42	-4166.20	897.97	-	-	-	-



Card 25, 92, 186 – Drop 3

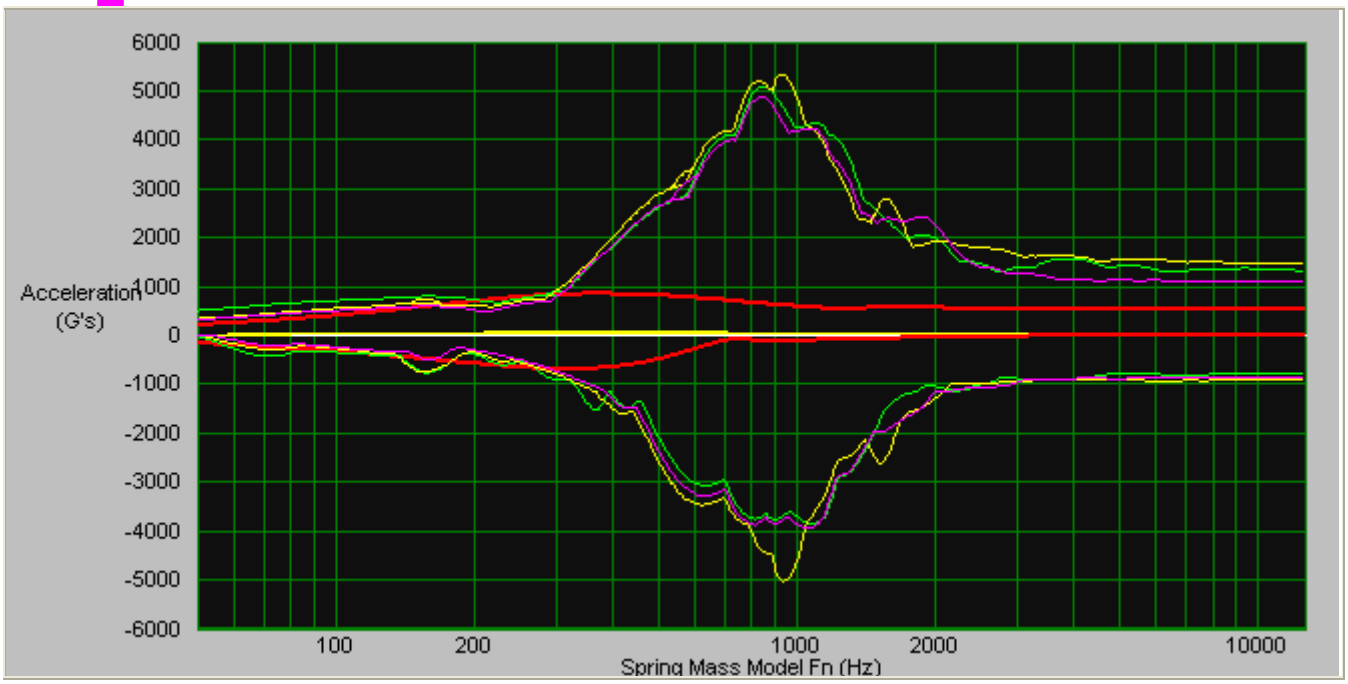
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	535.38	1.92	253.77	1288.66	535.38	-12.50
Ch2	25 (strain gauged)	1300.95	0.54	171.40	3472.22	1300.95	-765.33
Ch3	186	1478.79	0.56	195.85	4166.67	1478.79	-897.26
Ch4	92	1101.63	0.80	214.89	3205.13	1101.63	-847.83



Shock Response Spectra

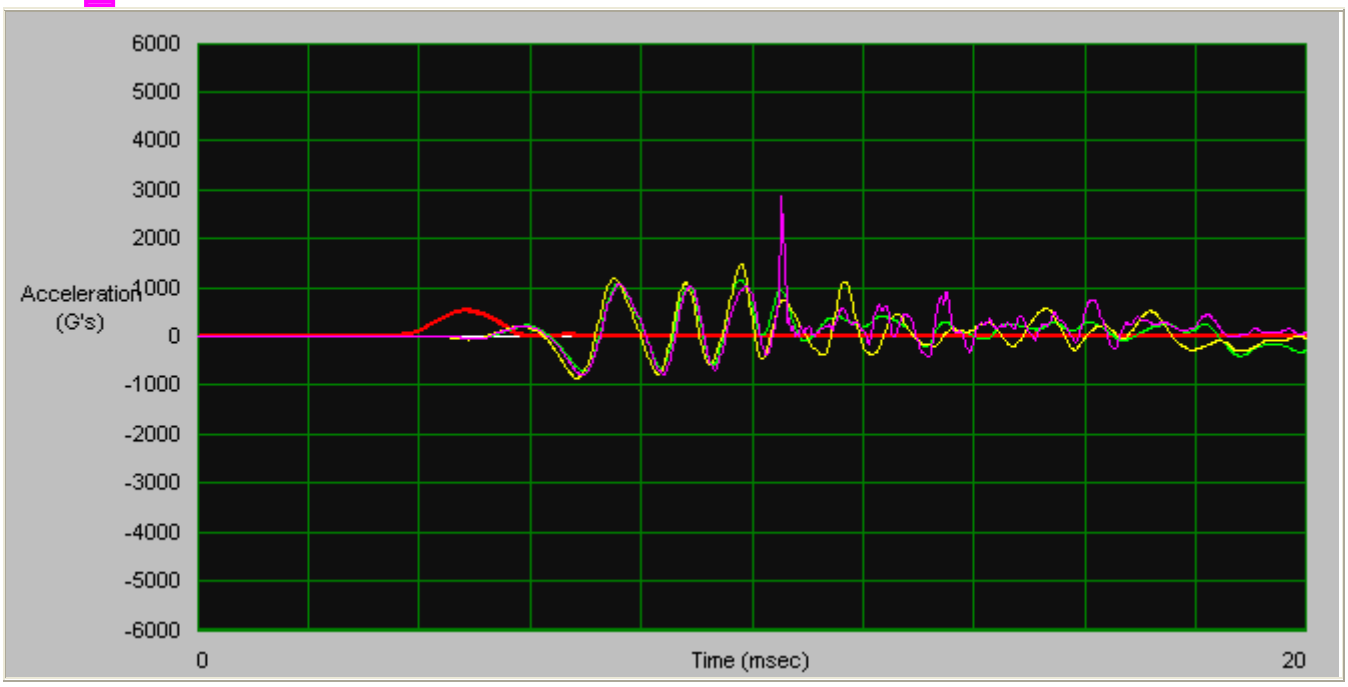
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	841.98	366.80	-692.22	317.48	-	-	-	-
SRS2	Composite	0.05	5086.19	847.57	-3844.89	1099.16	-	-	-	-
SRS3	Composite	0.05	5340.68	924.28	-5031.87	937.73	-	-	-	-
SRS4	Composite	0.05	4867.43	835.42	-3948.61	1067.87	-	-	-	-



Card 25, 92, 186 – Drop 4

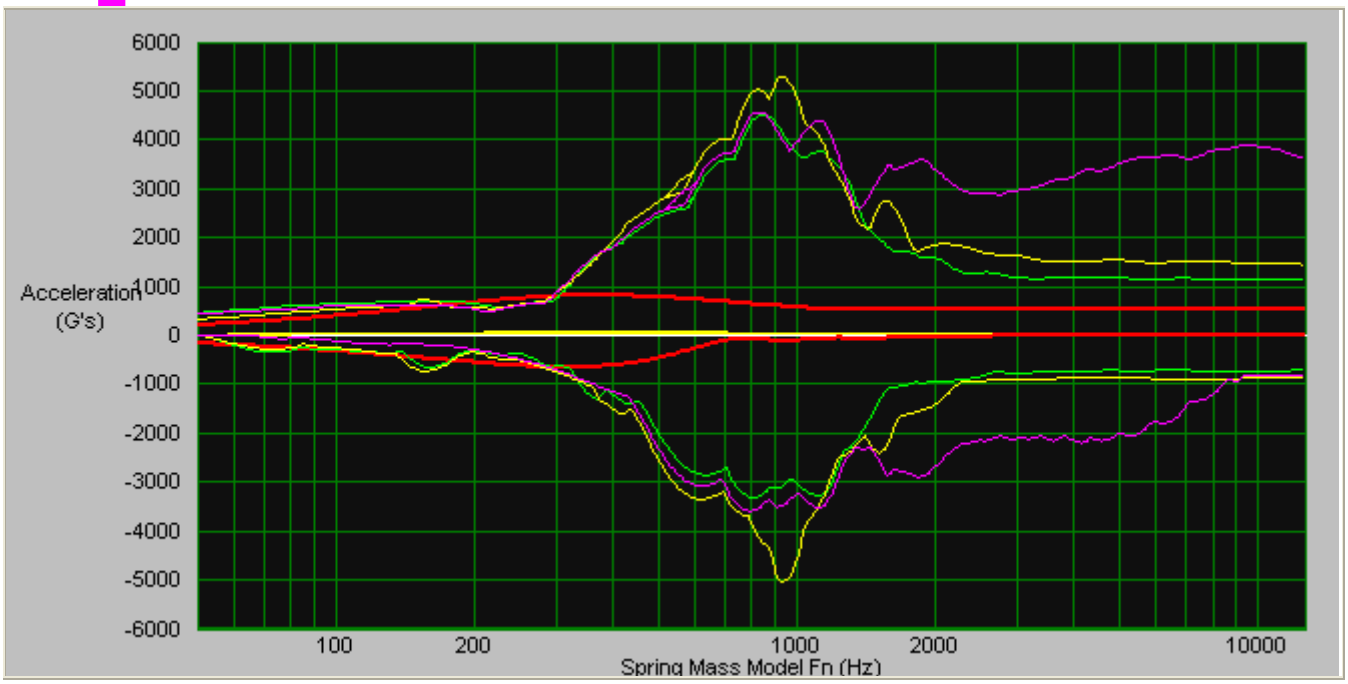
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	520.67	1.98	248.18	1262.63	520.67	-13.59
Ch2	25 (strain gauged)	1147.39	0.66	312.65	1838.24	1147.39	-711.94
Ch3	186	1460.01	0.56	192.73	4166.67	1460.01	-854.58
Ch4	92	2873.49	0.24	123.31	3787.88	2873.49	-789.47



Shock Response Spectra

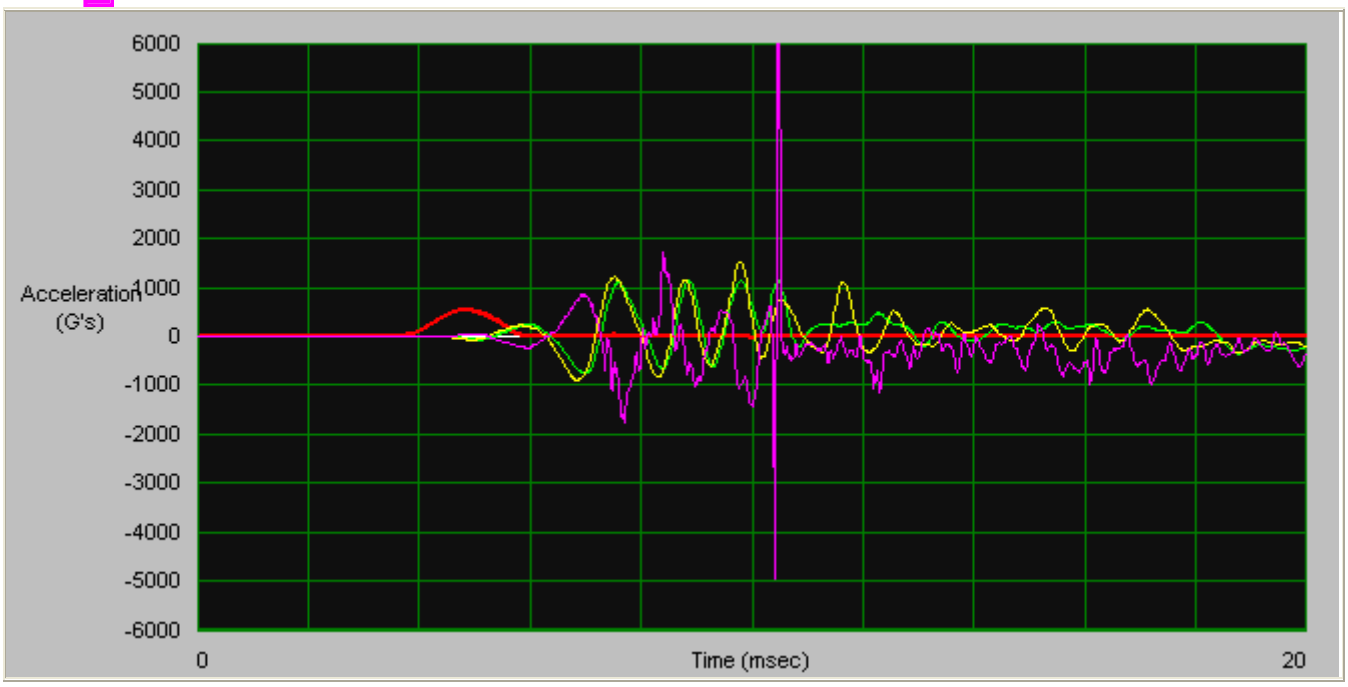
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	811.23	361.54	-654.42	312.93	-	-	-	-
SRS2	Composite	0.05	4516.94	847.57	-3330.68	800.00	-	-	-	-
SRS3	Composite	0.05	5290.22	937.73	-5040.36	937.73	-	-	-	-
SRS4	Composite	0.05	4564.26	823.44	-3593.98	788.53	-	-	-	-



Card 25, 92, 186 – Drop 5

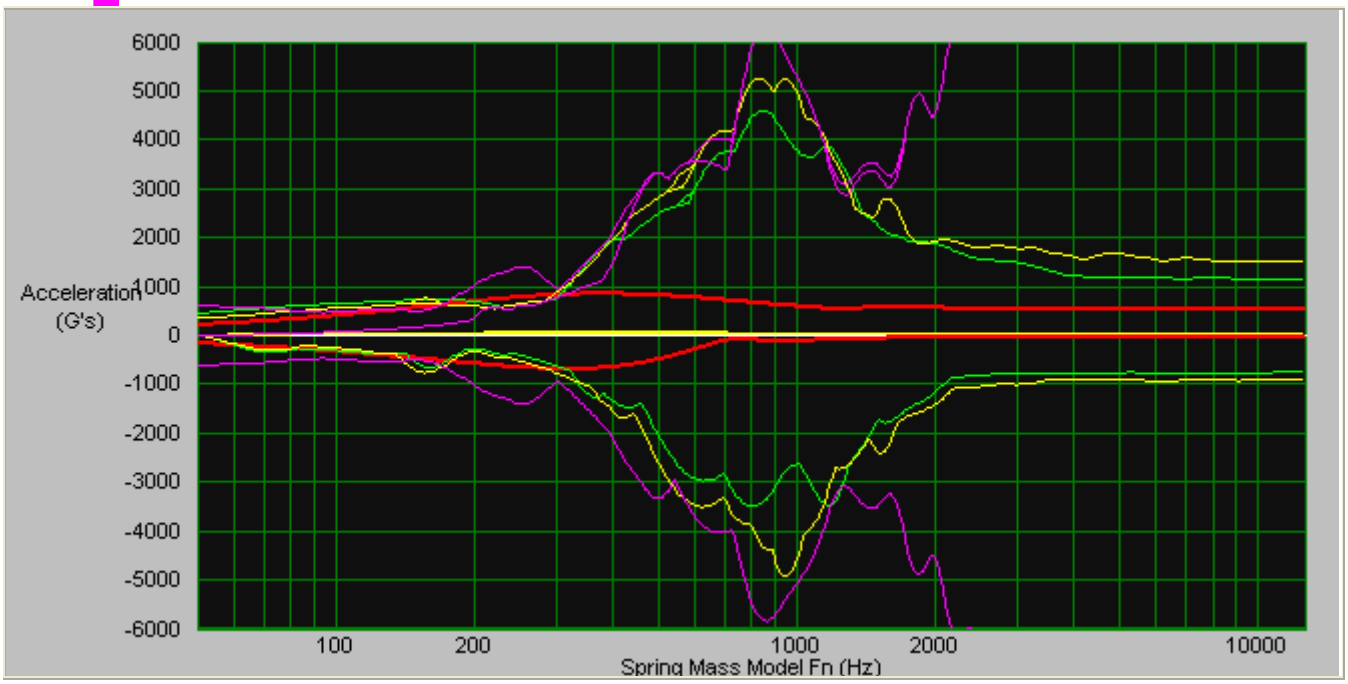
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	536.56	1.92	252.77	1302.08	536.56	-21.66
Ch2	25 (strain gauged)	1134.84	0.52	311.35	2016.13	1134.84	-753.21
Ch3	186	1511.62	0.56	198.95	4166.67	1511.62	-892.93
Ch4	92	9804.06	0.12	205.58	6250.00	9804.06	-4960.26



Shock Response Spectra

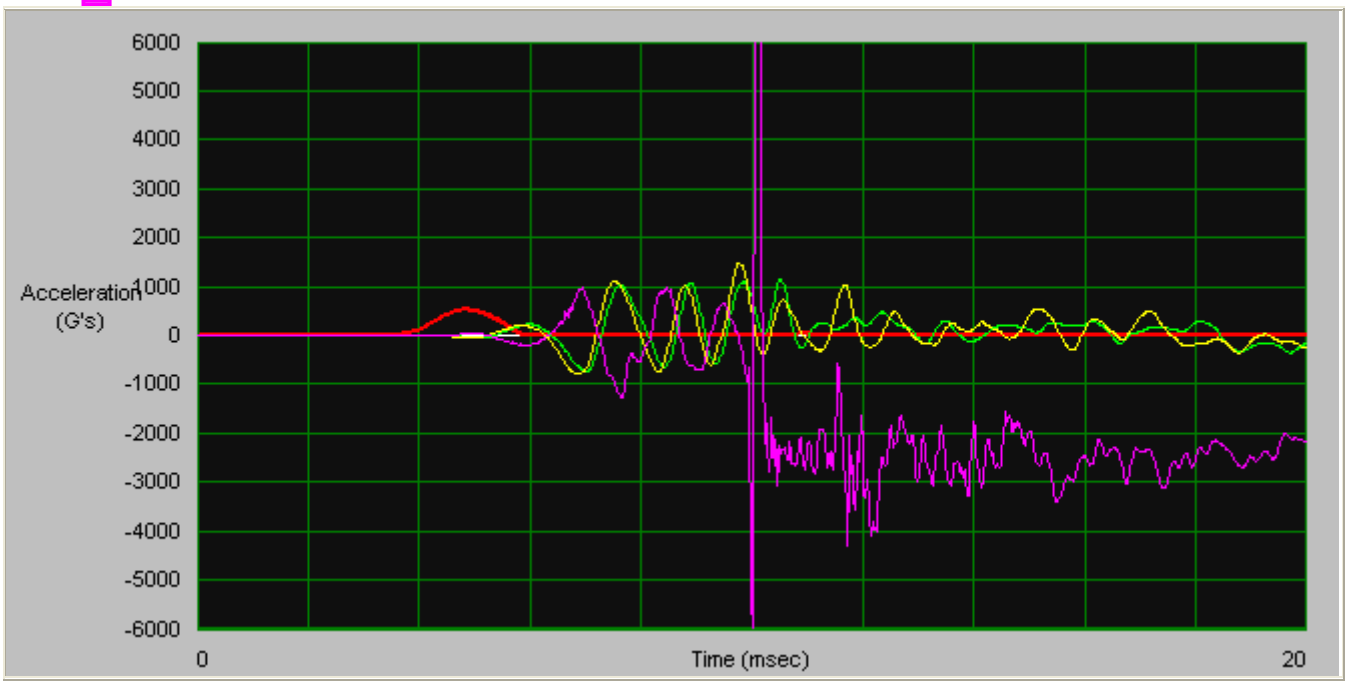
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	845.18	372.14	-687.67	322.10	-	-	-	-
SRS2	Composite	0.05	4591.80	847.57	-3495.82	811.64	-	-	-	-
SRS3	Composite	0.05	5256.79	835.42	-4918.83	951.37	-	-	-	-
SRS4	Composite	0.05	20291.25	8299.77	-16789.91	6040.80	-	-	-	-



Card 25, 92, 186 – Drop 6

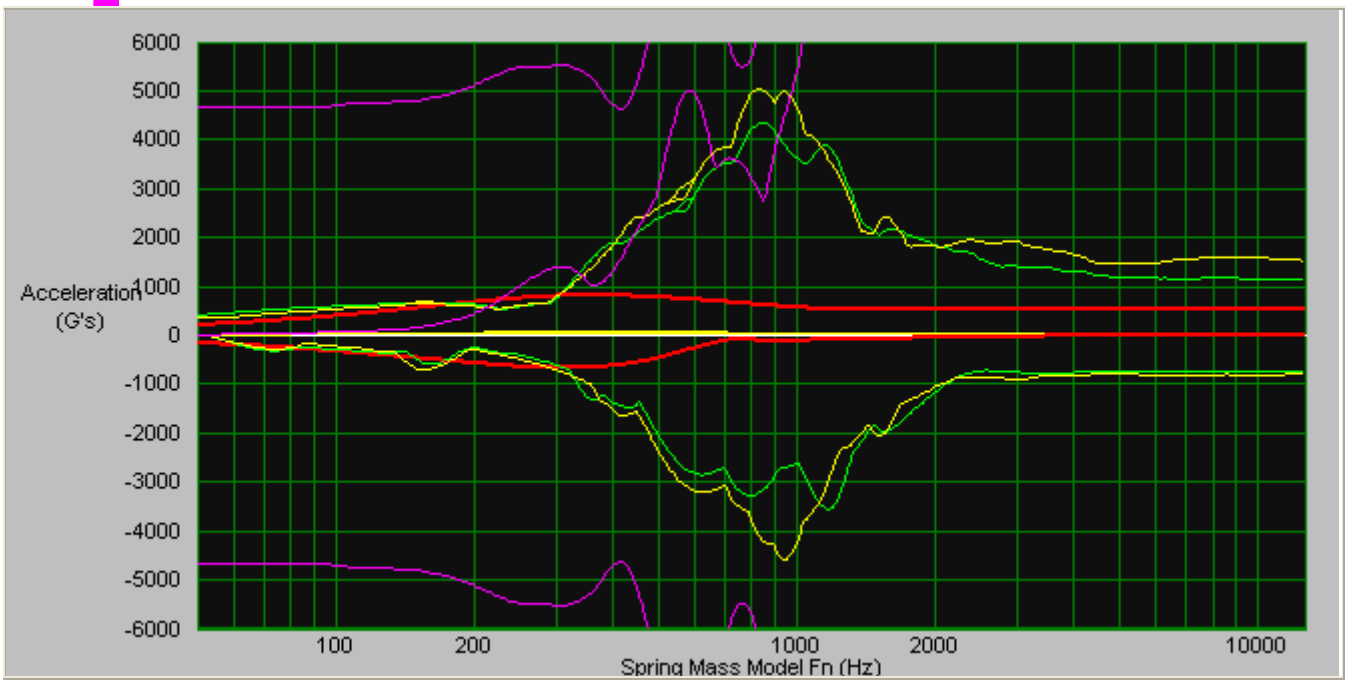
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	518.09	1.98	250.44	1262.63	518.09	-13.67
Ch2	25 (strain gauged)	1142.12	0.48	294.77	2016.13	1142.12	-726.89
Ch3	186	1474.12	0.58	199.54	4032.26	1474.12	-793.00
Ch4	92	10022.96	0.18	472.22	7352.94	10022.96	-7847.77



Shock Response Spectra

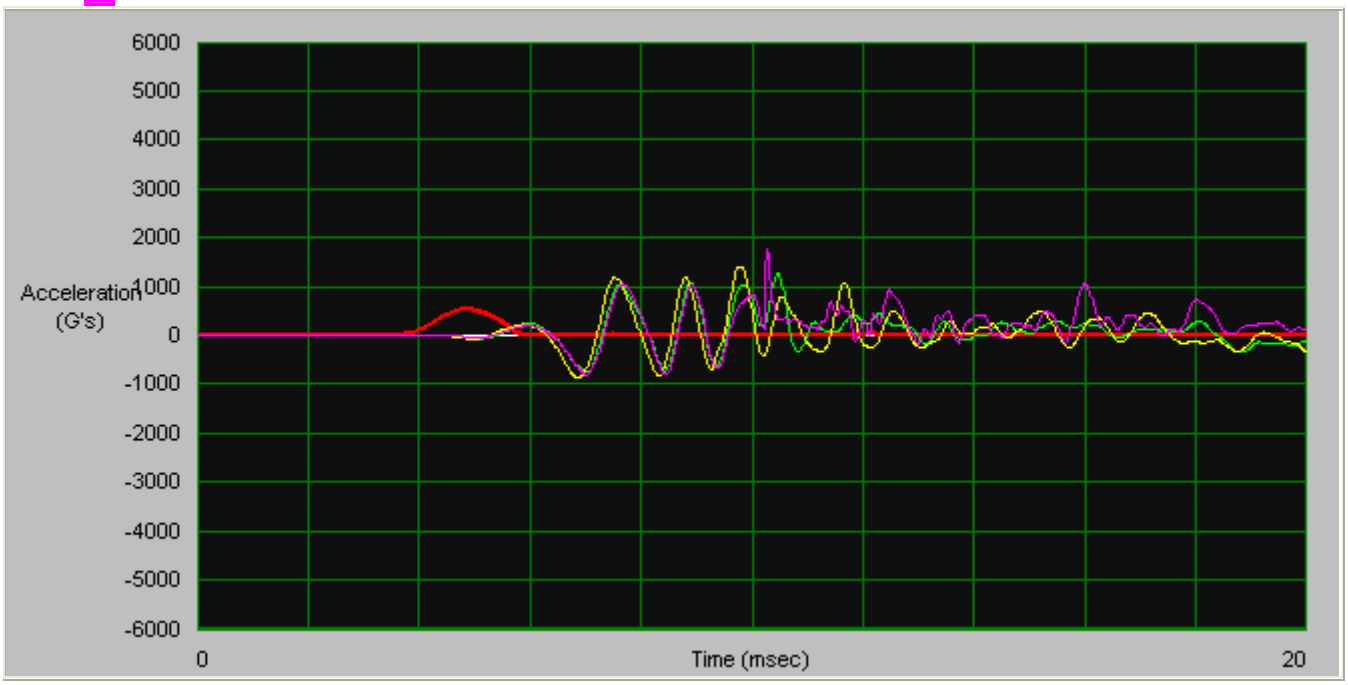
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	811.59	356.36	-670.32	308.44	-	-	-	-
SRS2	Composite	0.05	4337.40	847.57	-3560.76	1164.52	-	-	-	-
SRS3	Composite	0.05	5031.98	835.42	-4584.78	937.73	-	-	-	-
SRS4	Composite	0.05	24073.27	5701.75	-22342.68	3293.77	-	-	-	-



Card 25, 92, 186 – Drop 7

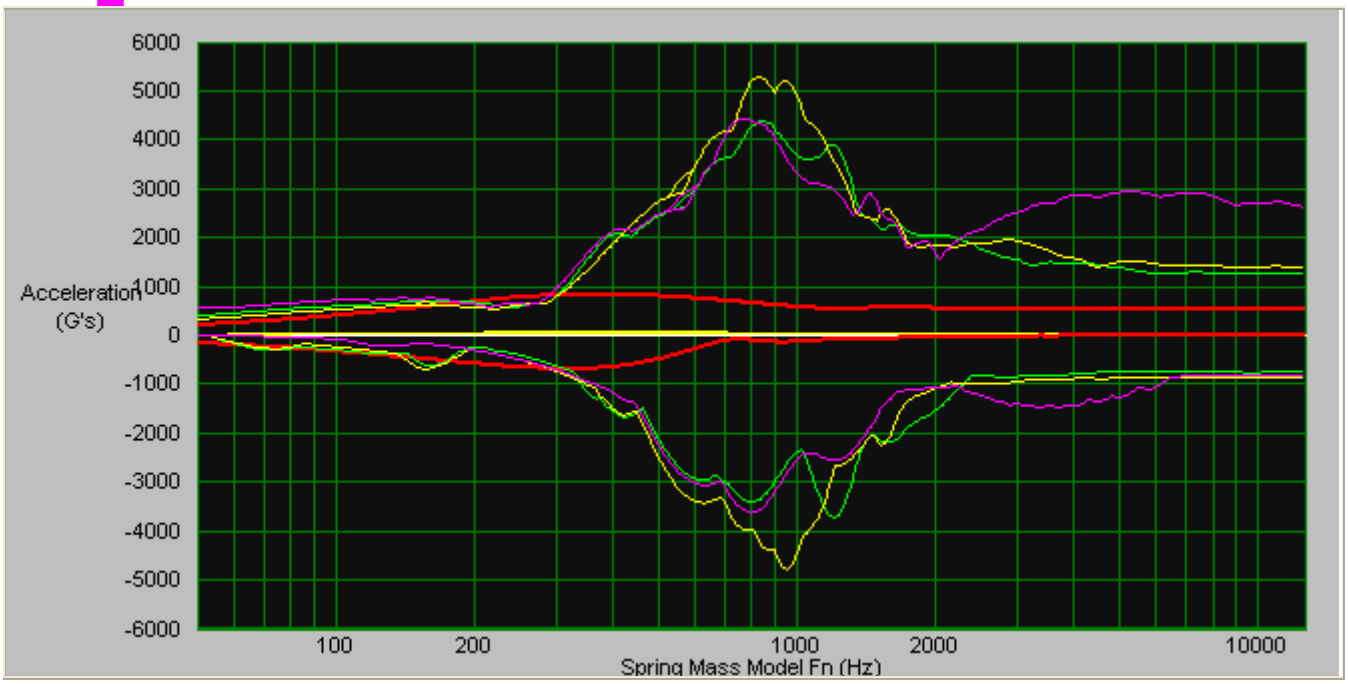
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	532.66	1.92	252.19	1288.66	532.66	-15.75
Ch2	25 (strain gauged)	1257.85	1.14	306.55	2155.17	1257.85	-745.61
Ch3	186	1395.91	0.54	191.36	4310.34	1395.91	-857.82
Ch4	92	1745.49	0.76	406.49	3205.13	1745.49	-804.01



Shock Response Spectra

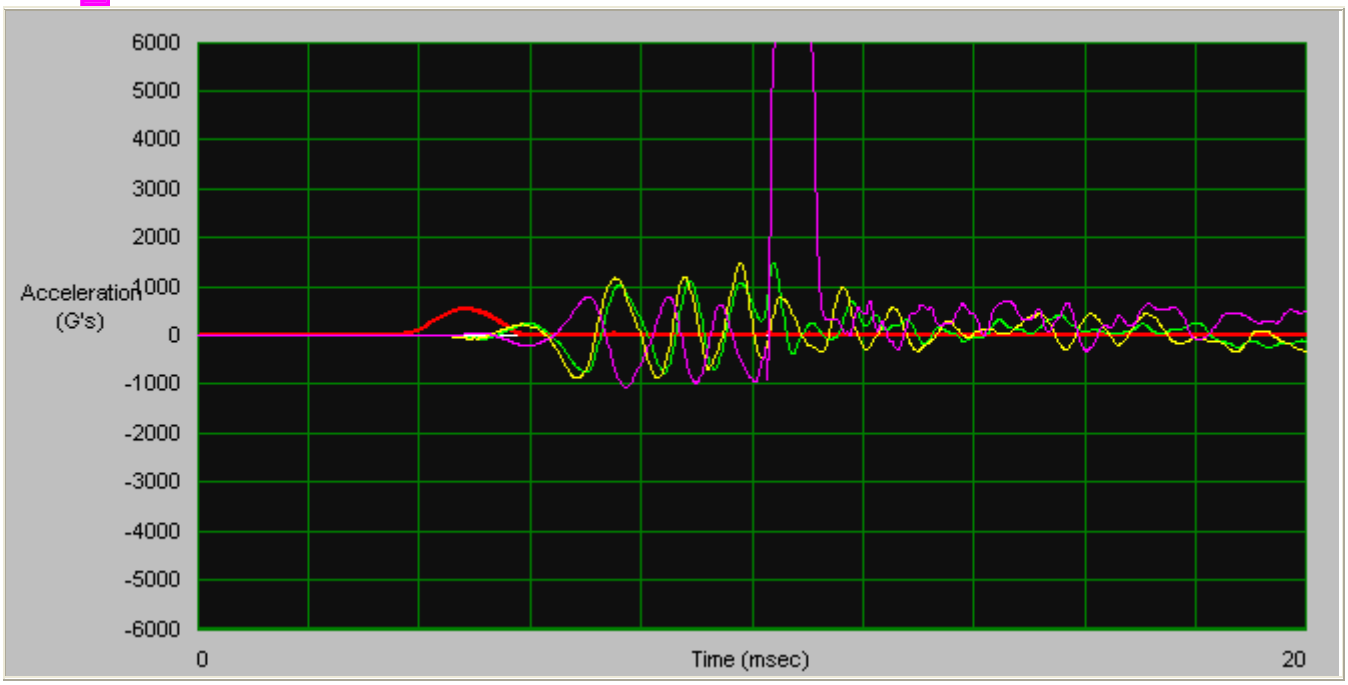
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	835.03	377.55	-687.74	322.10	-	-	-	-
SRS2	Composite	0.05	4373.74	847.57	-3721.70	1198.65	-	-	-	-
SRS3	Composite	0.05	5272.61	835.42	-4775.02	951.37	-	-	-	-
SRS4	Composite	0.05	4436.97	766.08	-3627.37	800.00	-	-	-	-



Card 25, 92, 186 – Drop 8

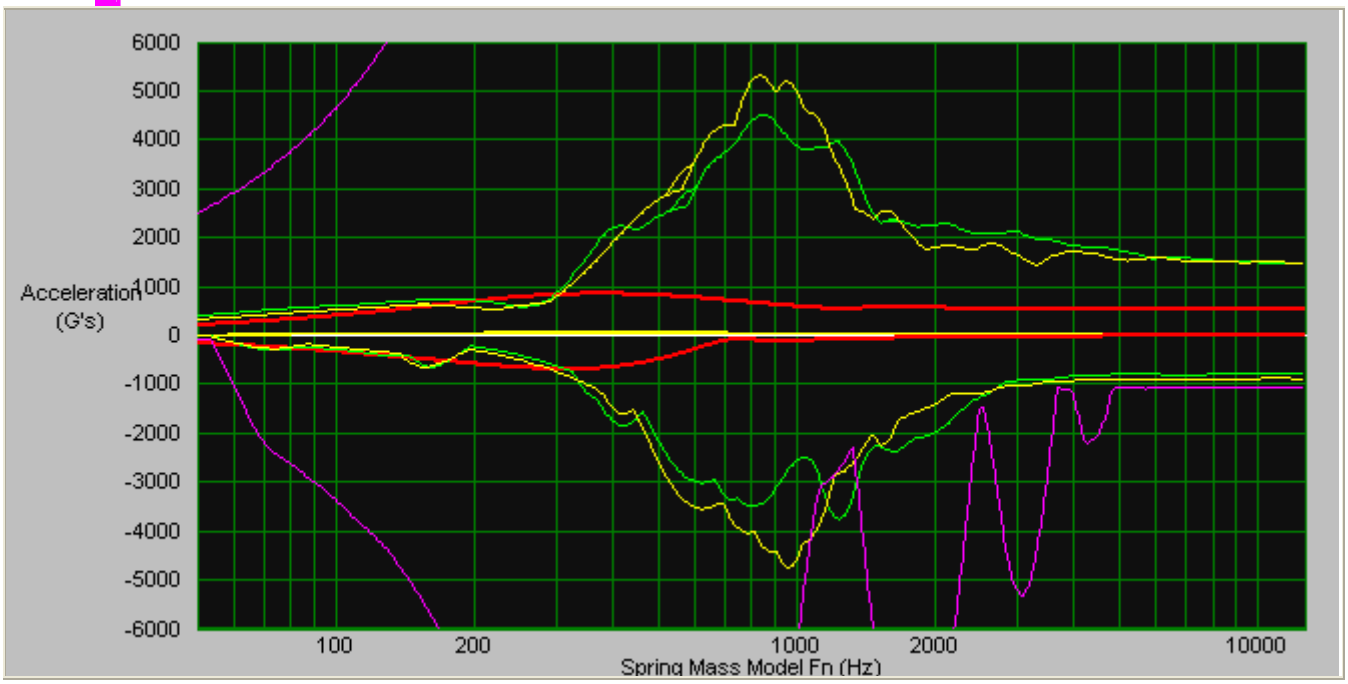
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	537.65	1.92	253.38	1302.08	537.65	-17.50
Ch2	25 (strain gauged)	1472.45	1.08	316.75	2272.73	1472.45	-772.60
Ch3	186	1473.38	0.54	189.28	4166.67	1473.38	-873.78
Ch4	92	10163.38	0.94	2925.07	2358.49	10163.38	-1061.21



Shock Response Spectra

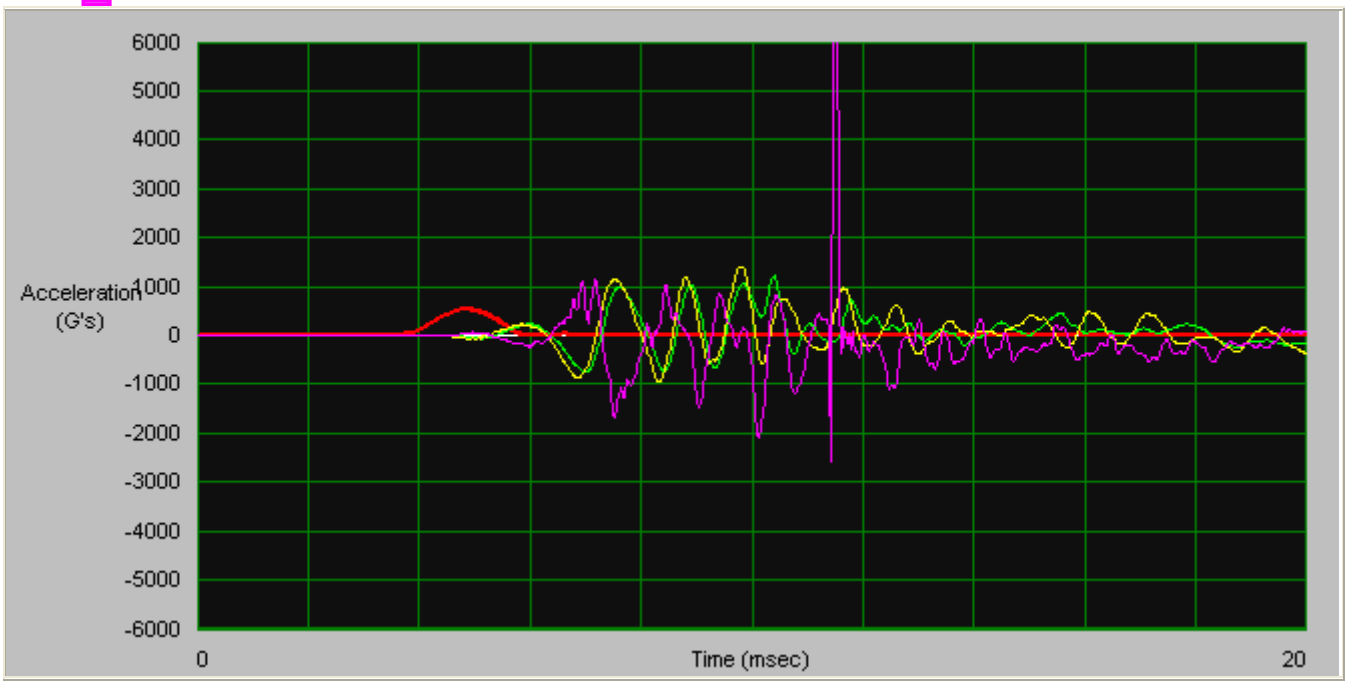
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	844.95	377.55	-693.57	322.10	-	-	-	-
SRS2	Composite	0.05	4497.05	847.57	-3754.65	1233.77	-	-	-	-
SRS3	Composite	0.05	5310.84	835.42	-4732.48	951.37	-	-	-	-
SRS4	Composite	0.05	22055.62	788.53	-16987.07	733.60	-	-	-	-



Card 25, 92, 186 – Drop 9

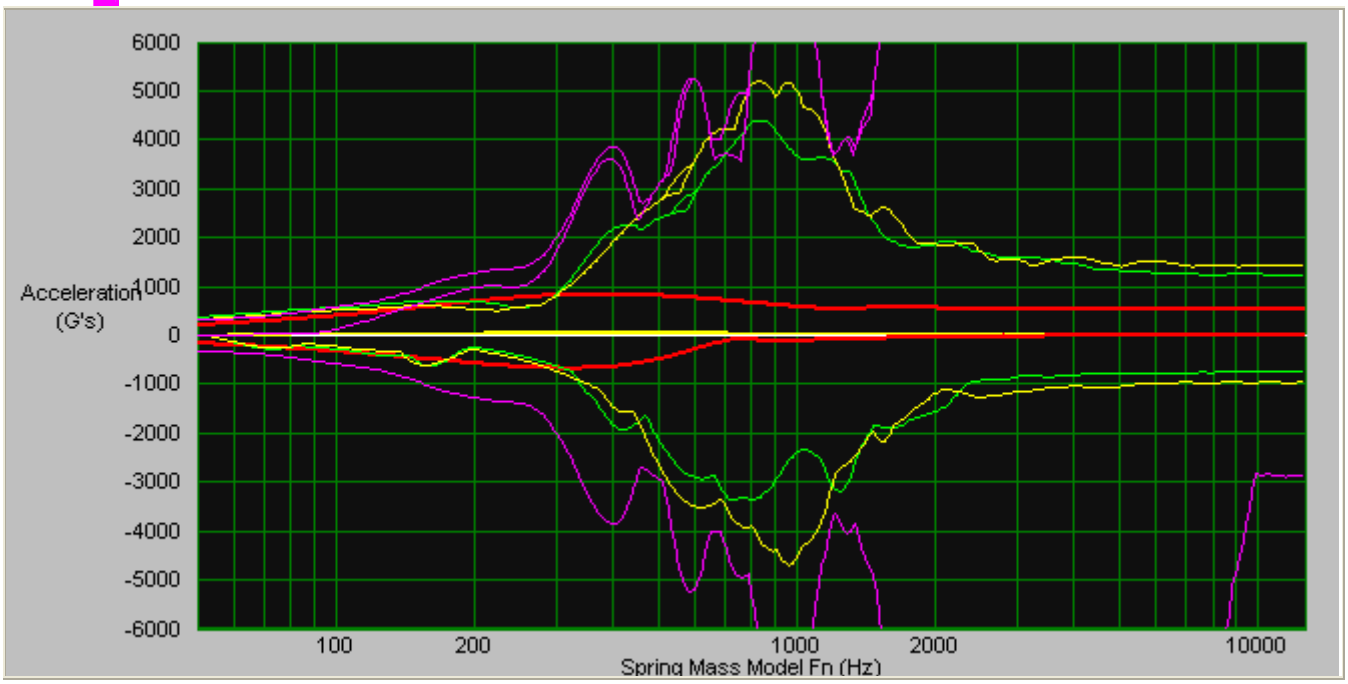
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	533.19	1.92	250.51	1302.08	533.19	-14.86
Ch2	25 (strain gauged)	1220.43	1.08	301.34	2272.73	1220.43	-745.92
Ch3	186	1408.50	0.56	192.02	4464.29	1408.50	-940.35
Ch4	92	10103.53	0.14	333.85	5208.33	10103.53	-2600.40



Shock Response Spectra

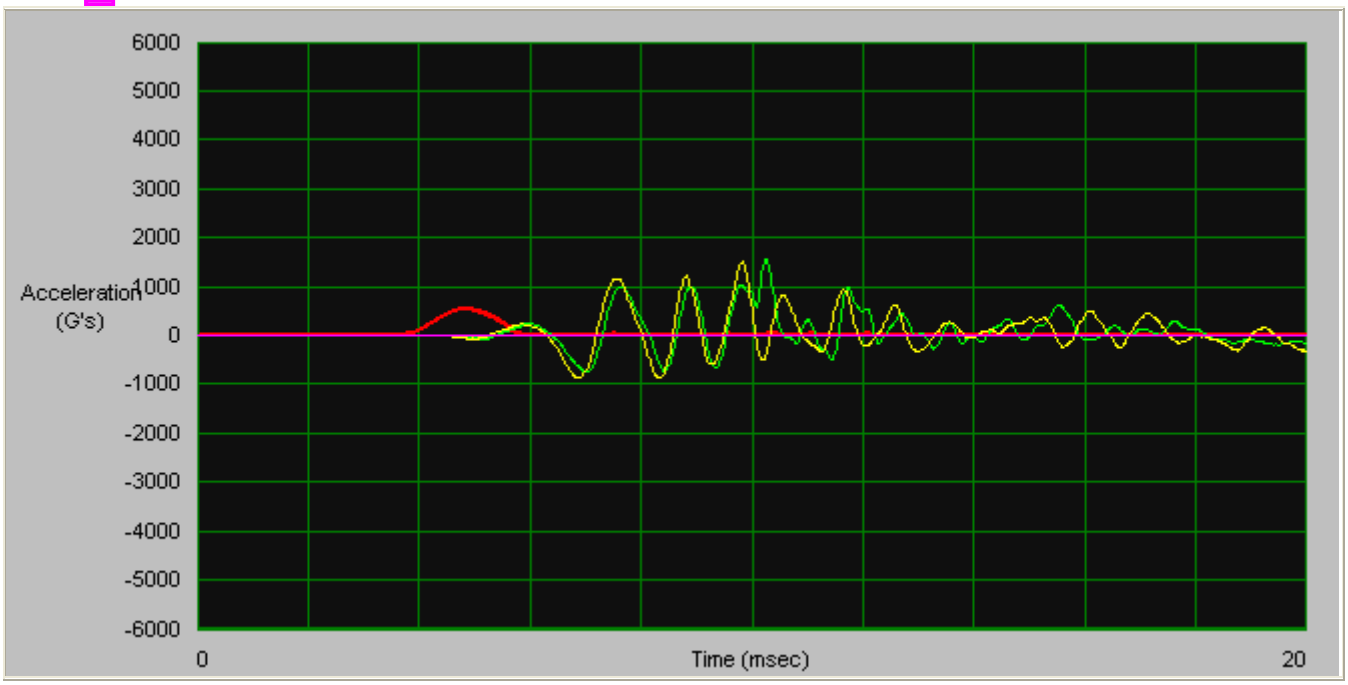
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	837.49	383.04	-677.26	322.10	-	-	-	-
SRS2	Composite	0.05	4395.22	835.42	-3377.43	733.60	-	-	-	-
SRS3	Composite	0.05	5201.07	835.42	-4696.86	965.20	-	-	-	-
SRS4	Composite	0.05	18487.62	5784.69	-14859.18	5304.58	-	-	-	-



Card 25, 92, 186 – Drop 10

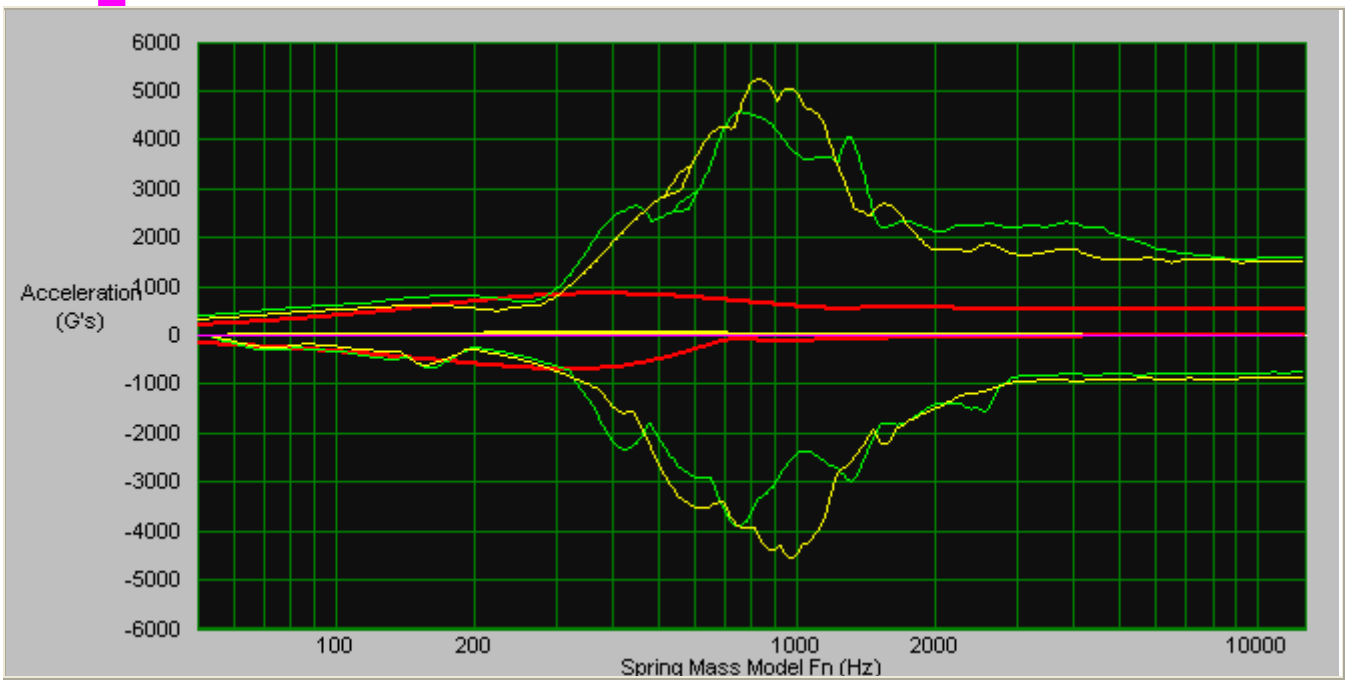
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	539.30	1.92	253.05	1302.08	539.30	-15.93
Ch2	25 (strain gauged)	1565.53	0.96	321.93	2403.85	1565.53	-755.08
Ch3	186	1498.68	0.56	191.73	4310.34	1498.68	-860.45
Ch4	92	9.77	20.00	67.49	125.00	9.77	7.32



Shock Response Spectra

	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	847.58	377.55	-692.82	326.78	-	-	-	-
SRS2	Composite	0.05	4568.21	755.10	-3905.99	744.27	-	-	-	-
SRS3	Composite	0.05	5238.72	835.42	-4557.10	979.24	-	-	-	-
SRS4	Composite	0.05	18.15	97.15	0.00	49.28	-	-	-	-

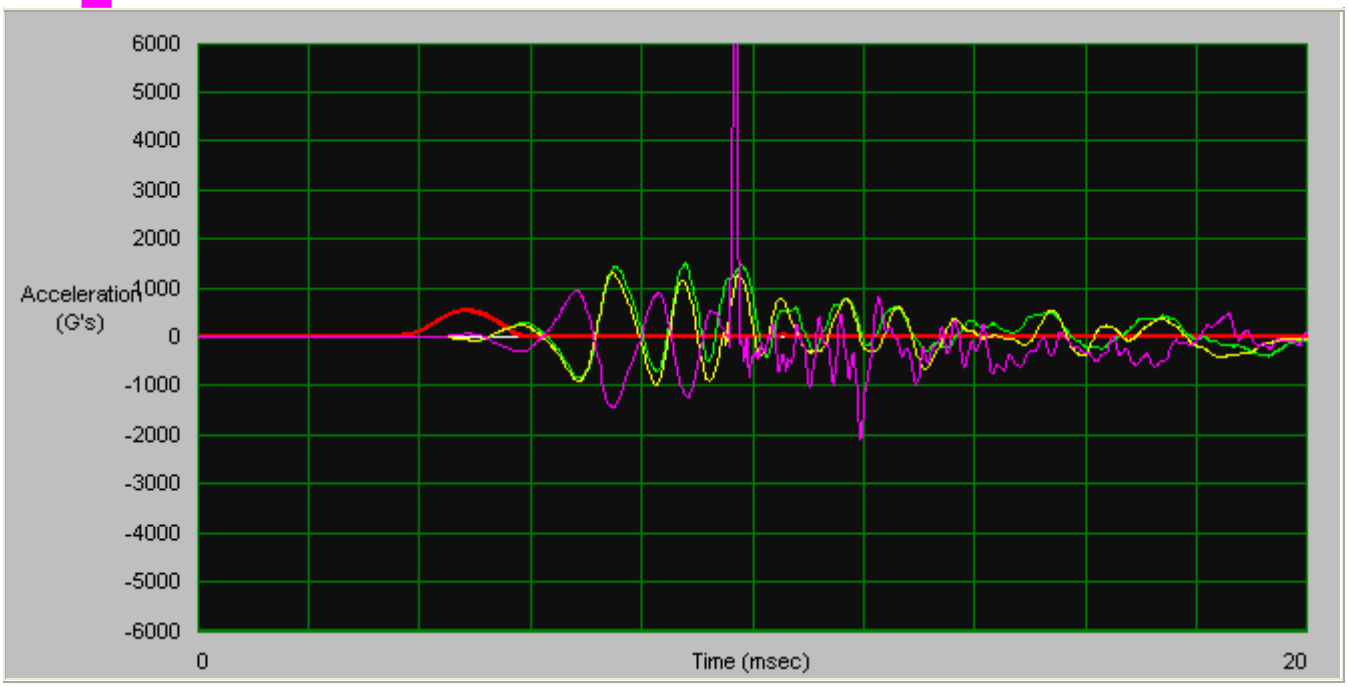


11.6 Set 6 – Card 29, 148 (strain gauged), 184

Card 29, 148, 184 – Drop 1

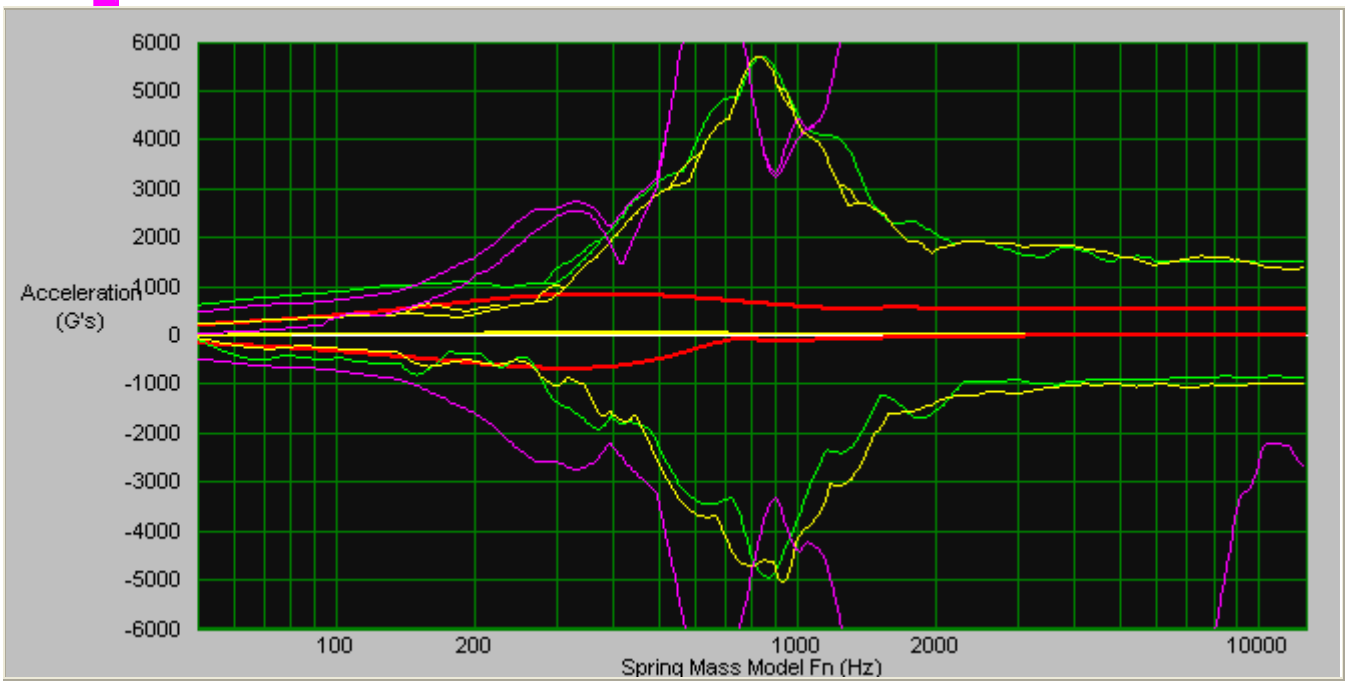
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	532.48	1.92	251.73	1288.66	532.48	-11.70
Ch2	148 (strain gauged)	1496.79	0.60	221.34	3125.00	1496.79	-830.59
Ch3	29	1329.39	0.76	240.31	3289.47	1329.39	-977.27
Ch4	184	10082.67	0.16	367.91	5434.78	10082.67	-2076.57



Shock Response Spectra

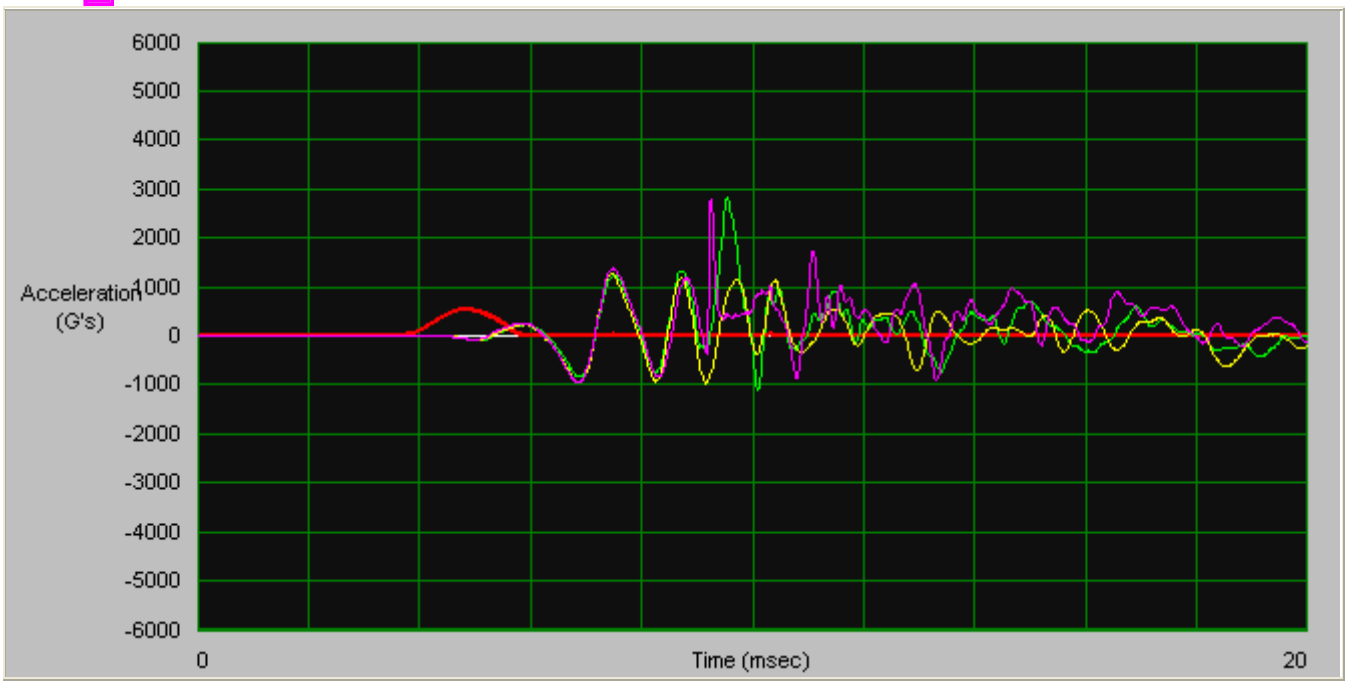
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	838.17	377.55	-684.05	322.10	-	-	-	-
SRS2	Composite	0.05	5696.02	835.42	-4954.25	859.90	-	-	-	-
SRS3	Composite	0.05	5698.60	823.44	-5053.03	937.73	-	-	-	-
SRS4	Composite	0.05	16206.90	5079.68	-13640.23	3860.81	-	-	-	-



Card 29, 148, 184 – Drop 2

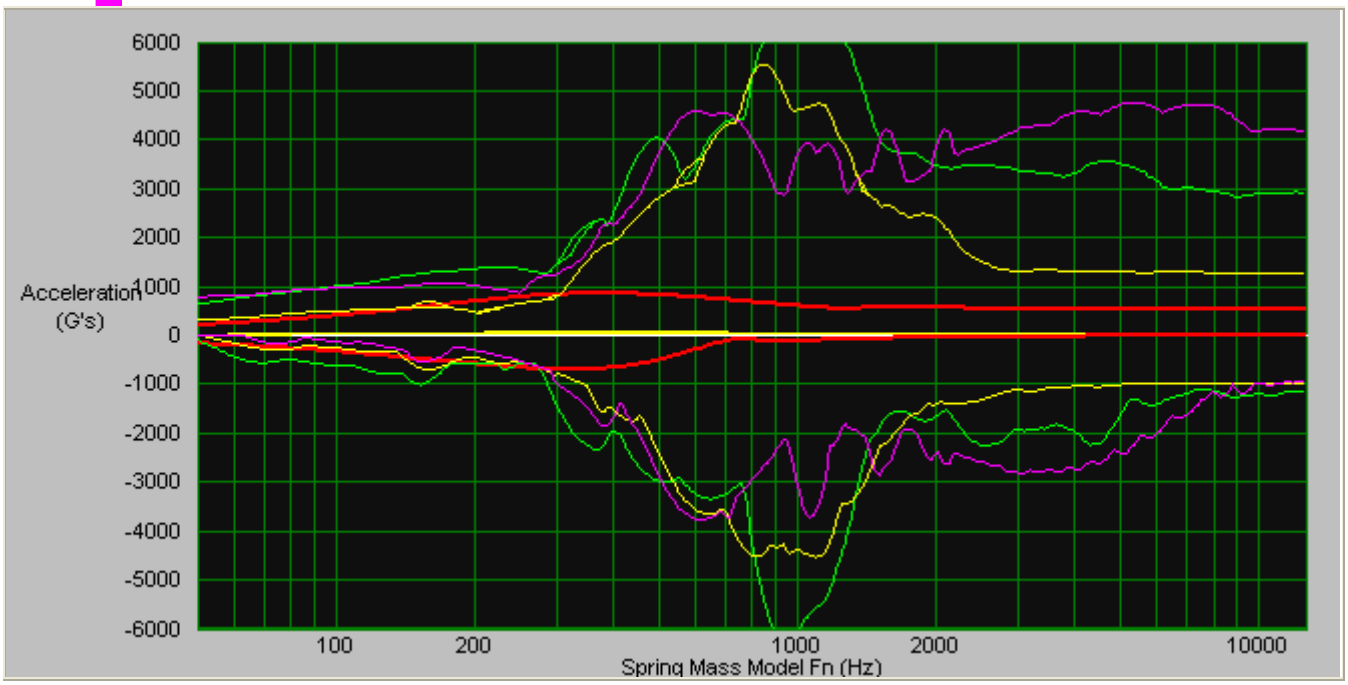
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	541.02	1.92	253.60	1302.08	541.02	-15.92
Ch2	148 (strain gauged)	2845.14	0.70	404.31	3571.43	2845.14	-1121.92
Ch3	29	1264.38	0.76	227.30	3378.38	1264.38	-965.40
Ch4	184	2769.22	1.38	376.20	3048.78	2769.22	-957.87



Shock Response Spectra

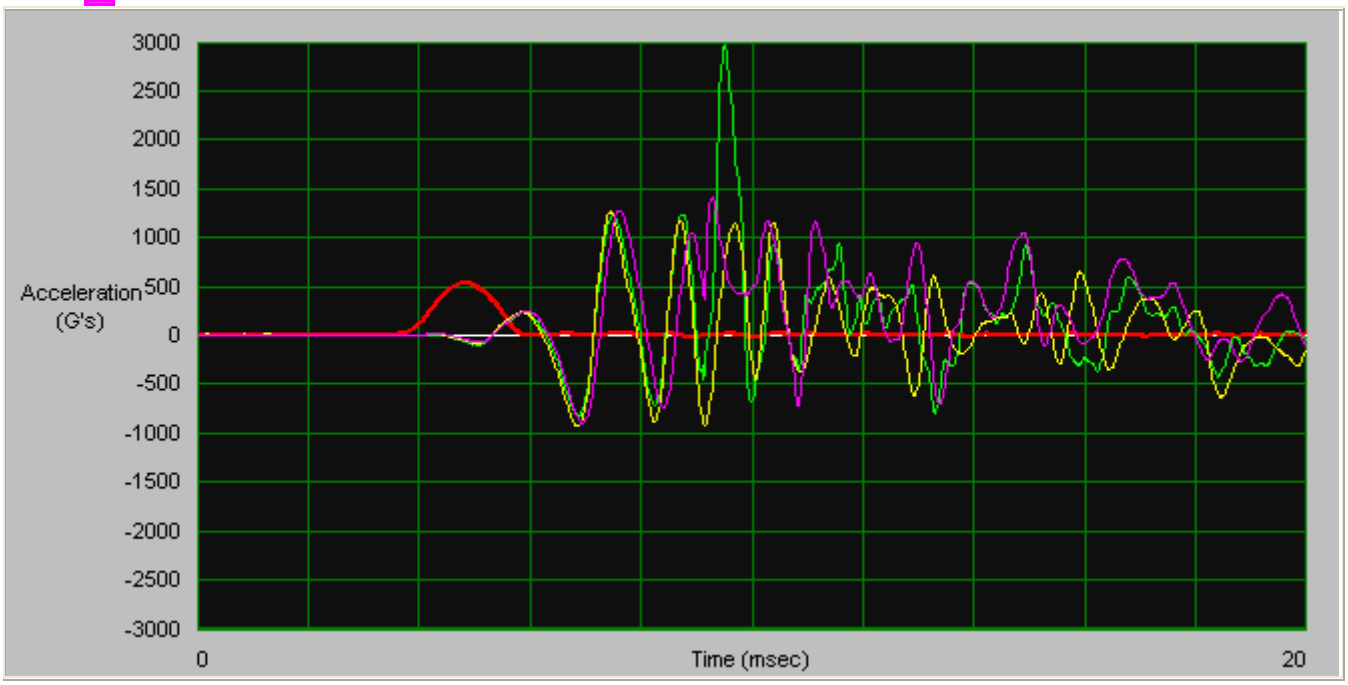
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	850.71	372.14	-701.24	326.78	-	-	-	-
SRS2	Composite	0.05	6520.10	911.03	-6251.67	937.73	-	-	-	-
SRS3	Composite	0.05	5530.35	847.57	-4528.18	1099.16	-	-	-	-
SRS4	Composite	0.05	4766.47	5304.58	-3774.80	616.88	-	-	-	-



Card 29, 148, 184 – Drop 3

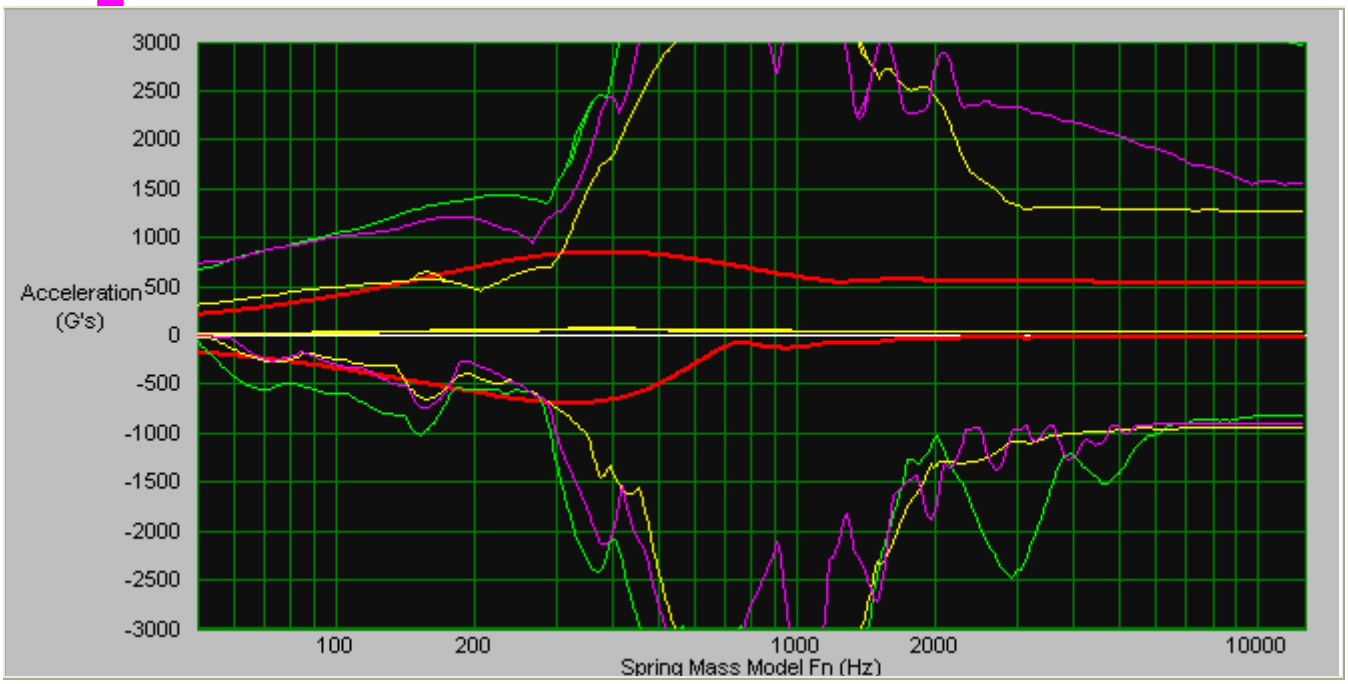
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	539.45	1.90	252.37	1315.79	539.45	-16.89
Ch2	148 (strain gauged)	2968.68	0.60	434.55	3676.47	2968.68	-814.54
Ch3	29	1262.46	0.74	224.65	3378.38	1262.46	-929.43
Ch4	184	1418.33	1.96	566.01	1275.51	1418.33	-896.13



Shock Response Spectra

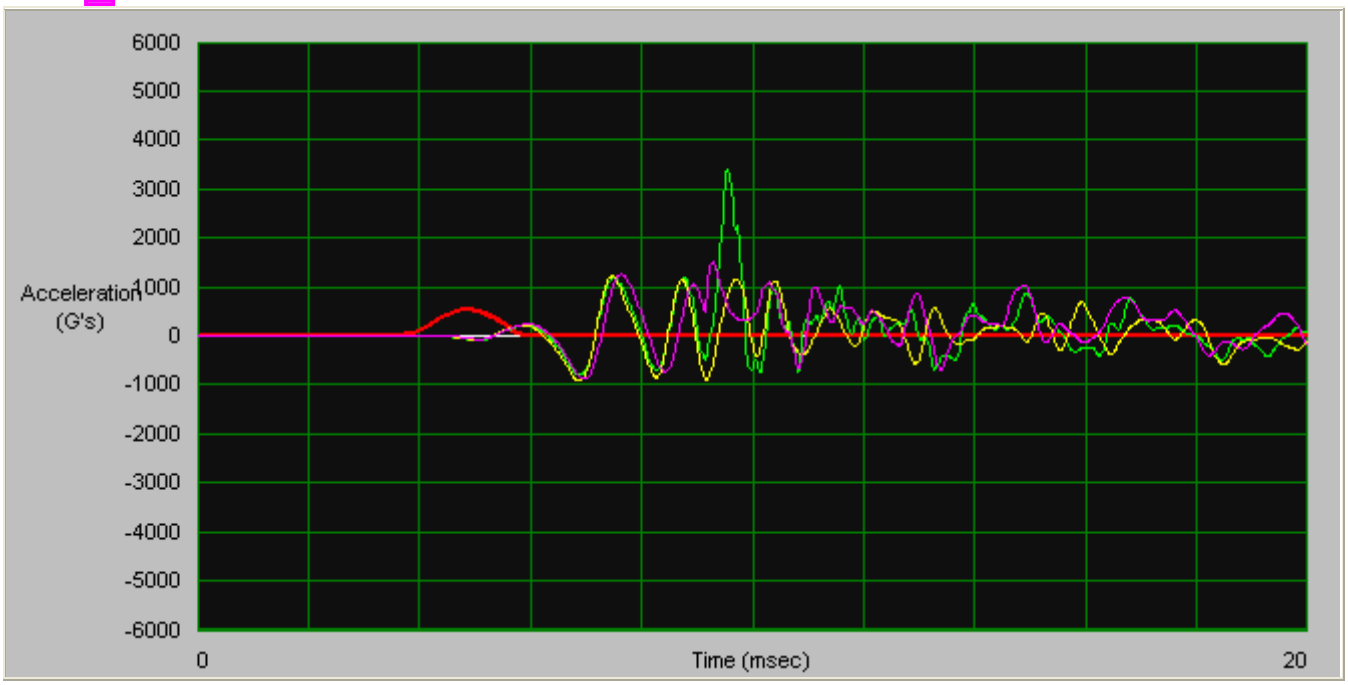
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	849.15	377.55	-694.29	322.10	-	-	-	-
SRS2	Composite	0.05	6725.11	924.28	-6412.25	937.73	-	-	-	-
SRS3	Composite	0.05	5393.42	847.57	-4637.89	1099.16	-	-	-	-
SRS4	Composite	0.05	4813.66	599.32	-3921.20	1052.56	-	-	-	-



Card 29, 148, 184 – Drop 4

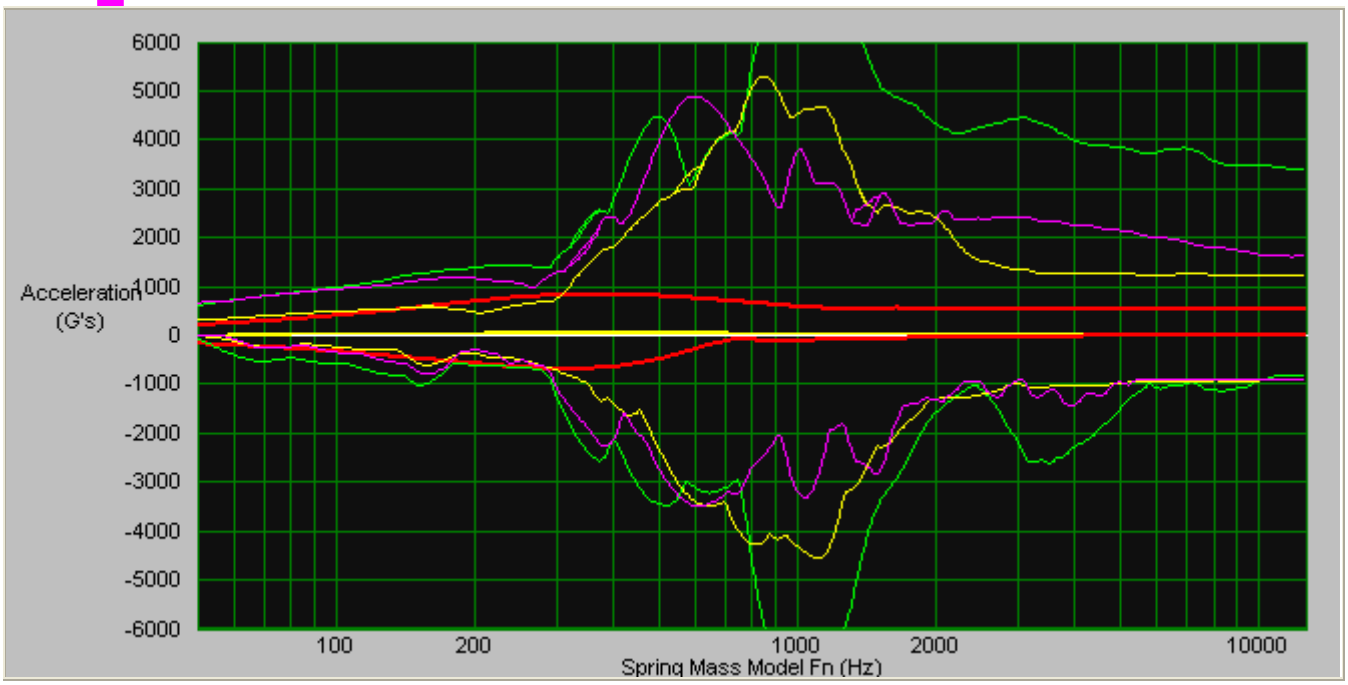
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	531.17	1.94	252.60	1288.66	531.17	-15.15
Ch2	148 (strain gauged)	3414.50	0.58	444.34	3906.25	3414.50	-798.54
Ch3	29	1222.18	0.74	219.80	3289.47	1222.18	-907.62
Ch4	184	1506.28	1.90	544.07	1302.08	1506.28	-880.50



Shock Response Spectra

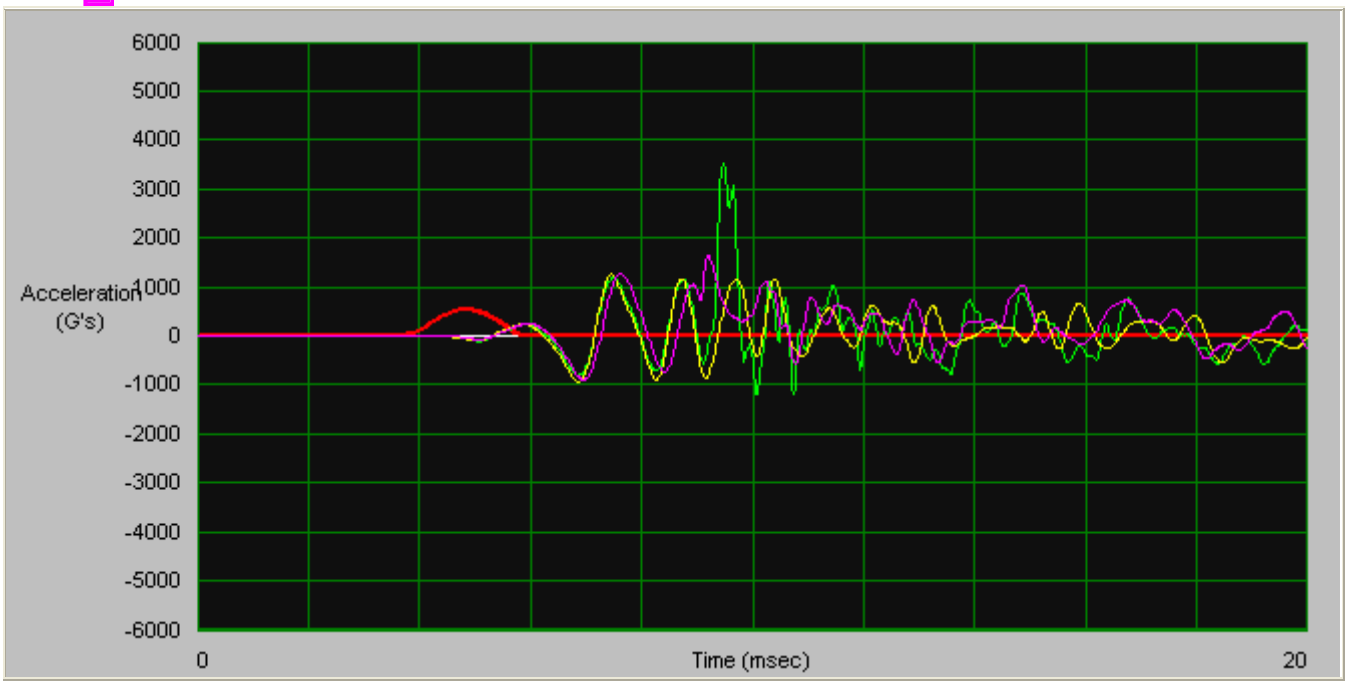
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	836.04	366.80	-688.31	317.48	-	-	-	-
SRS2	Composite	0.05	7024.54	924.28	-6919.08	951.37	-	-	-	-
SRS3	Composite	0.05	5292.05	847.57	-4555.15	1115.15	-	-	-	-
SRS4	Composite	0.05	4892.75	599.32	-3490.23	608.04	-	-	-	-



Card 29, 148, 184 – Drop 5

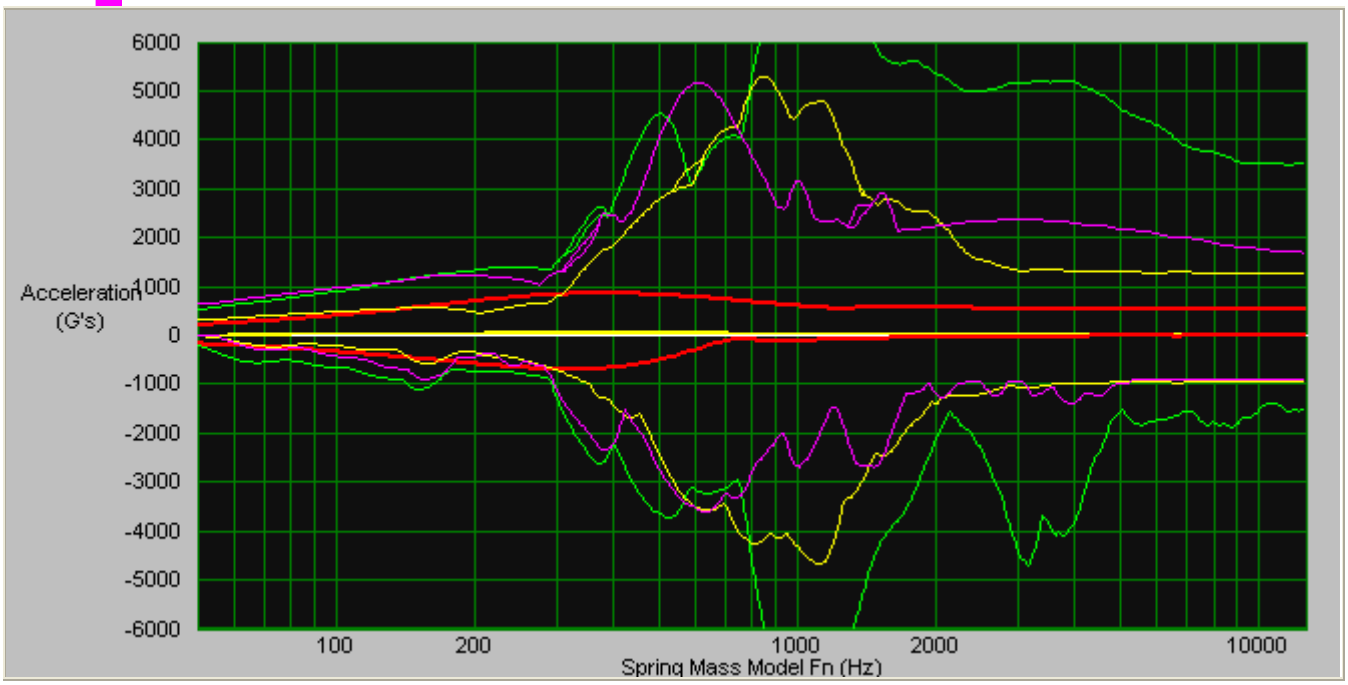
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	543.56	1.90	253.44	1315.79	543.56	-18.42
Ch2	148 (strain gauged)	3515.16	0.48	432.59	4166.67	3515.16	-1206.46
Ch3	29	1254.30	0.76	224.38	3289.47	1254.30	-926.24
Ch4	184	1627.93	1.98	563.58	1262.63	1627.93	-892.61



Shock Response Spectra

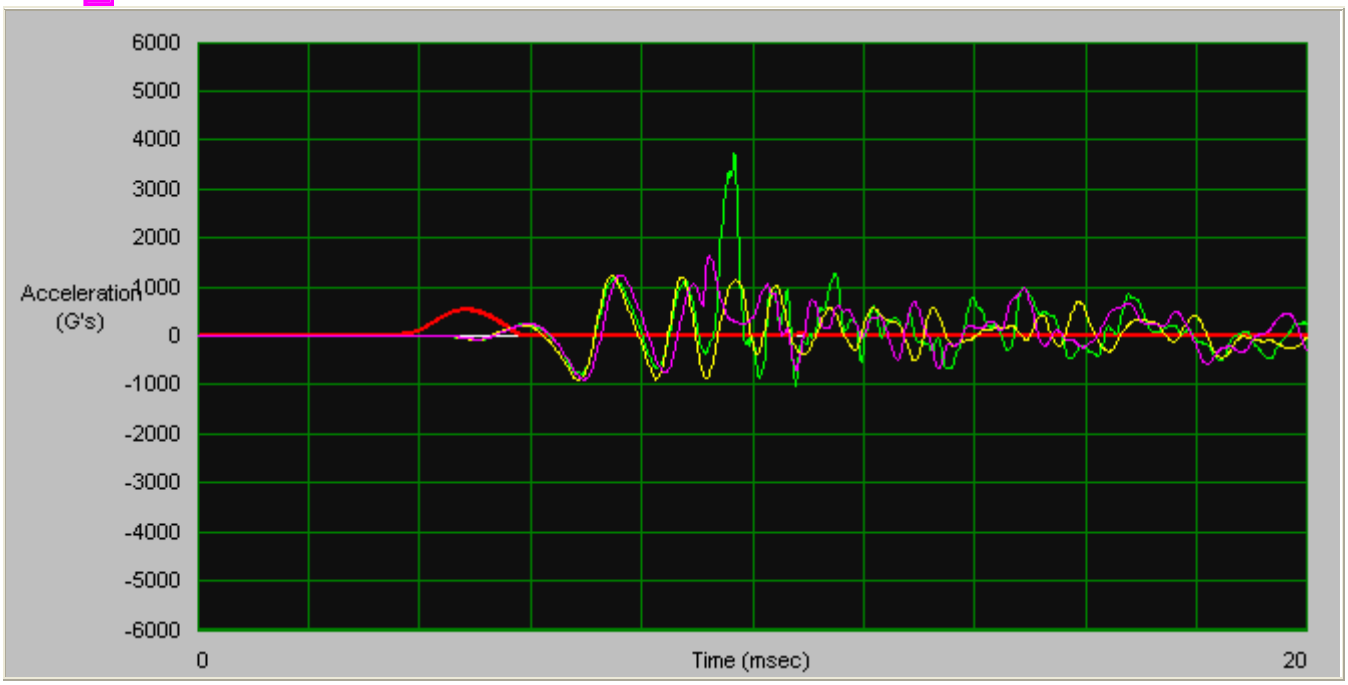
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	853.90	377.55	-698.13	326.78	-	-	-	-
SRS2	Composite	0.05	7422.62	1216.08	-7223.12	951.37	-	-	-	-
SRS3	Composite	0.05	5284.46	847.57	-4675.16	1115.15	-	-	-	-
SRS4	Composite	0.05	5169.08	608.04	-3619.69	634.96	-	-	-	-



Card 29, 148, 184 – Drop 6

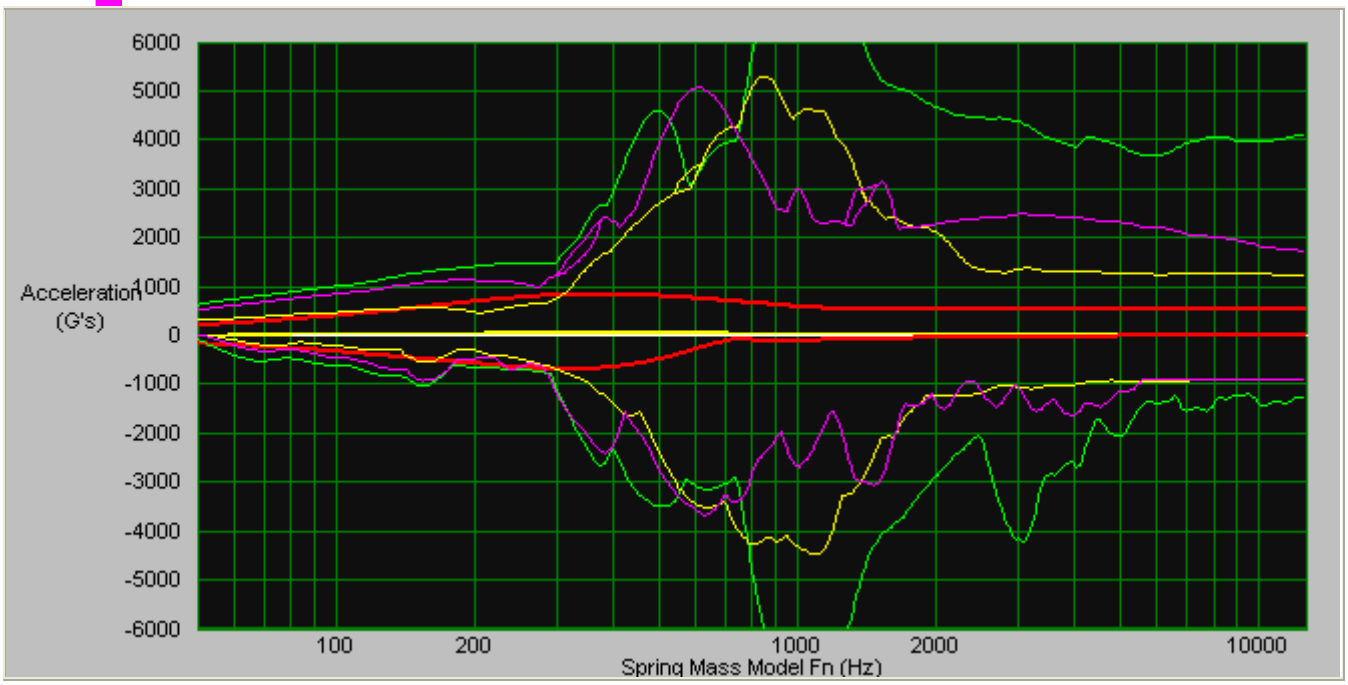
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	530.04	1.92	251.85	1288.66	530.04	-17.81
Ch2	148 (strain gauged)	3724.87	0.48	449.64	3787.88	3724.87	-1022.42
Ch3	29	1236.31	0.76	221.55	3289.47	1236.31	-884.59
Ch4	184	1622.69	1.82	509.78	1358.70	1622.69	-887.96



Shock Response Spectra

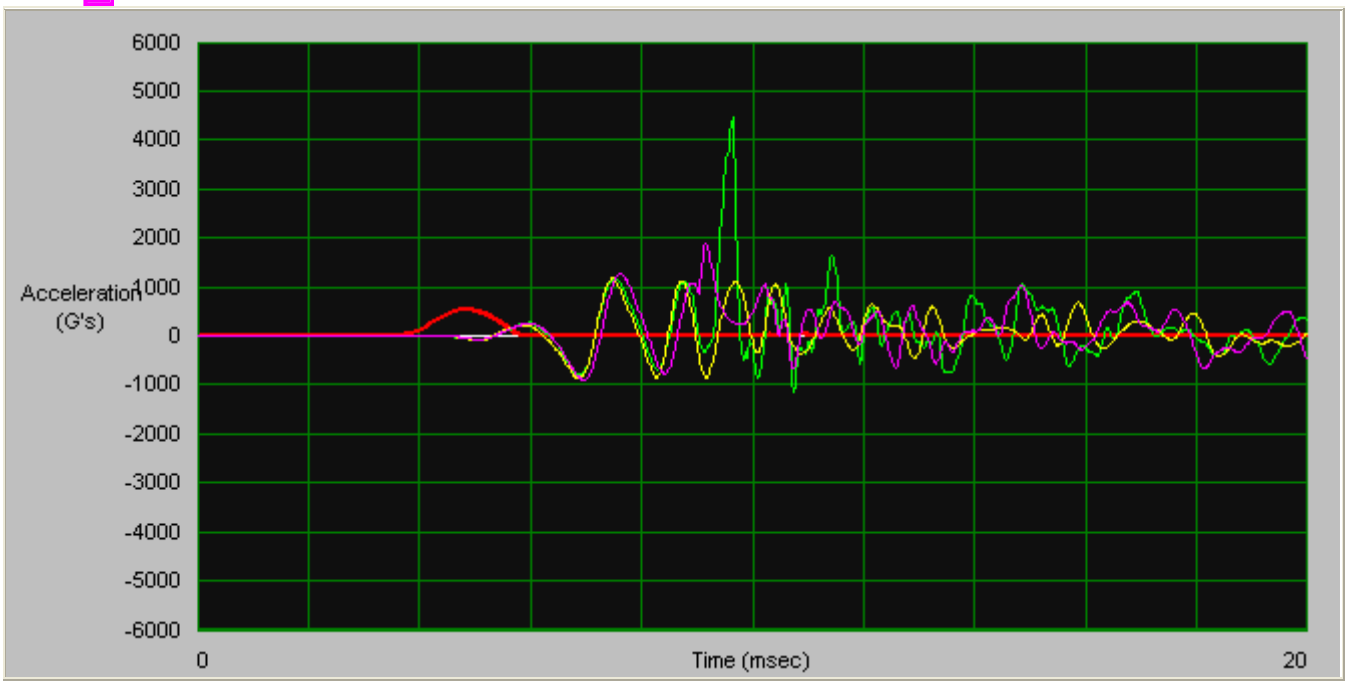
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	834.22	366.80	-694.03	322.10	-	-	-	-
SRS2	Composite	0.05	7365.63	1181.46	-6928.61	951.37	-	-	-	-
SRS3	Composite	0.05	5294.69	847.57	-4481.87	1099.16	-	-	-	-
SRS4	Composite	0.05	5062.52	608.04	-3677.59	625.86	-	-	-	-



Card 29, 148, 184 – Drop 7

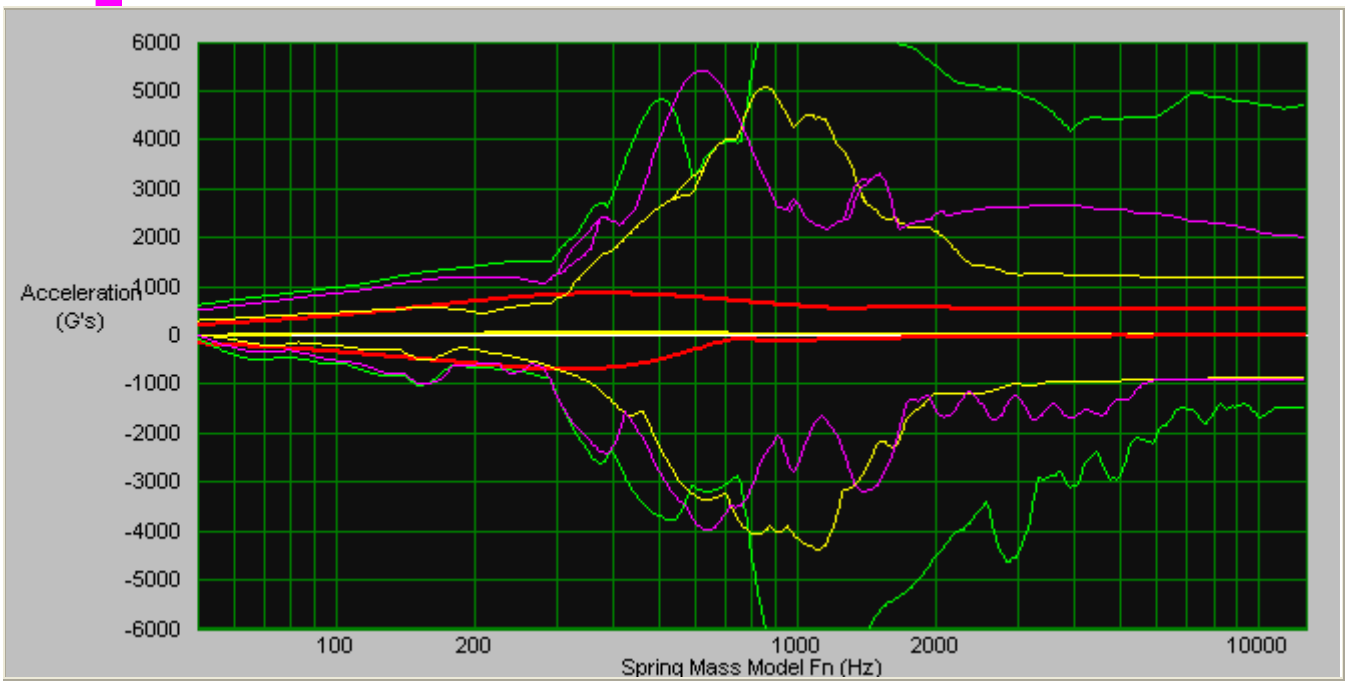
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	538.52	1.92	253.24	1302.08	538.52	-16.53
Ch2	148 (strain gauged)	4461.10	0.46	454.72	4166.67	4461.10	-1157.16
Ch3	29	1176.45	0.76	212.02	3205.13	1176.45	-863.97
Ch4	184	1880.45	1.76	517.80	1404.49	1880.45	-904.50



Shock Response Spectra

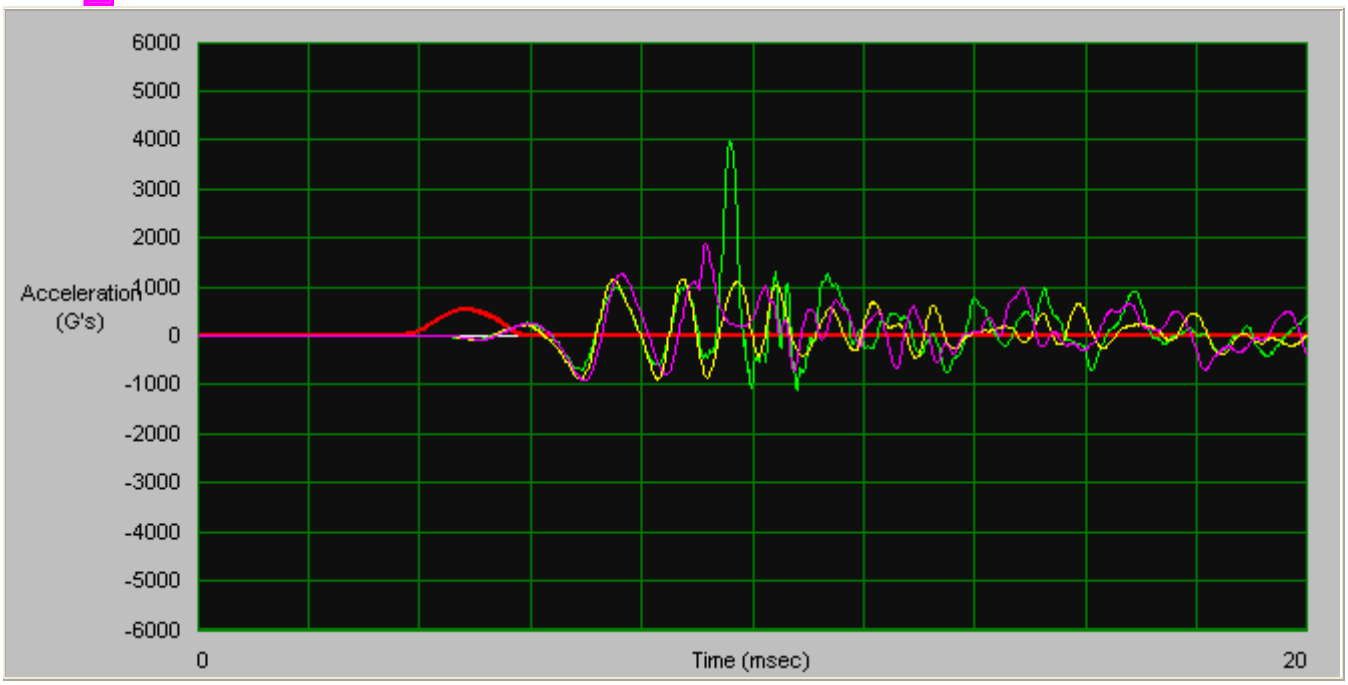
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	848.22	377.55	-700.30	322.10	-	-	-	-
SRS2	Composite	0.05	8127.27	1216.08	-7625.26	1198.65	-	-	-	-
SRS3	Composite	0.05	5068.91	847.57	-4364.00	1099.16	-	-	-	-
SRS4	Composite	0.05	5416.52	616.88	-3980.96	634.96	-	-	-	-



Card 29, 148, 184 – Drop 8

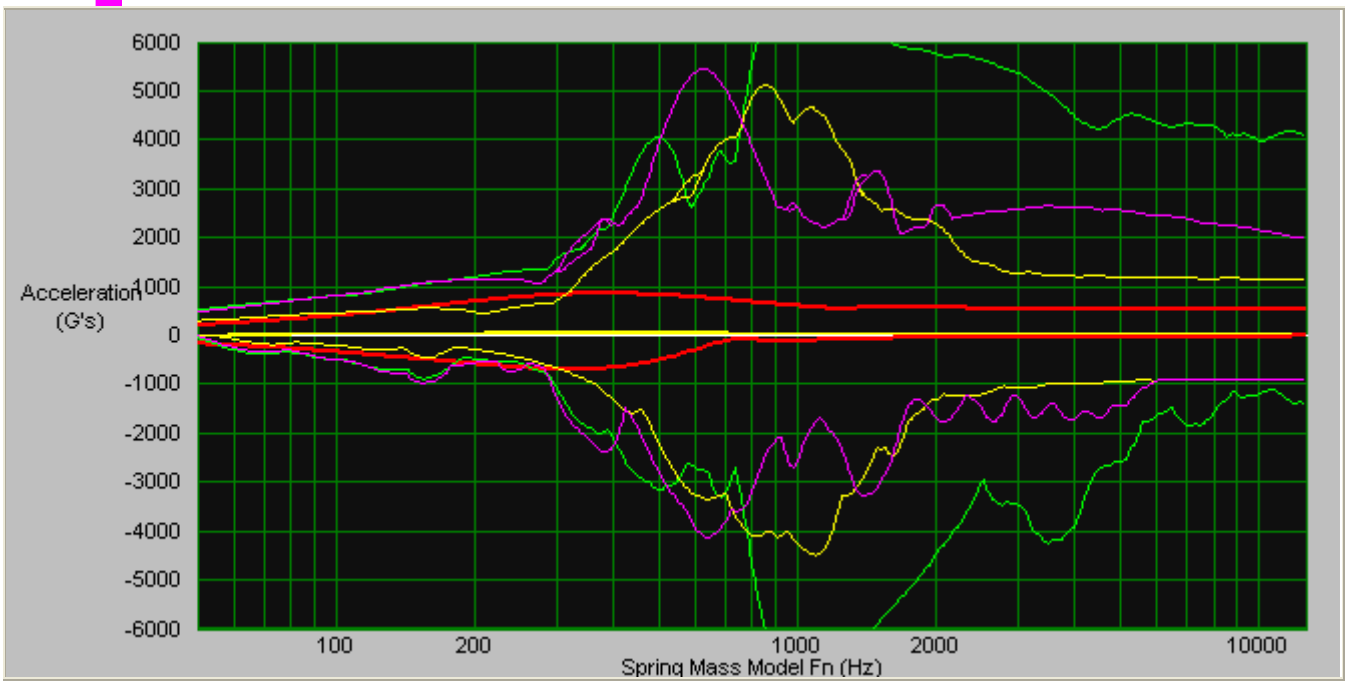
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	541.47	1.88	252.50	1315.79	541.47	-20.10
Ch2	148 (strain gauged)	3981.34	0.44	411.15	4629.63	3981.34	-1095.97
Ch3	29	1157.05	0.50	142.46	3205.13	1157.05	-885.07
Ch4	184	1889.69	1.76	491.56	1420.45	1889.69	-906.89



Shock Response Spectra

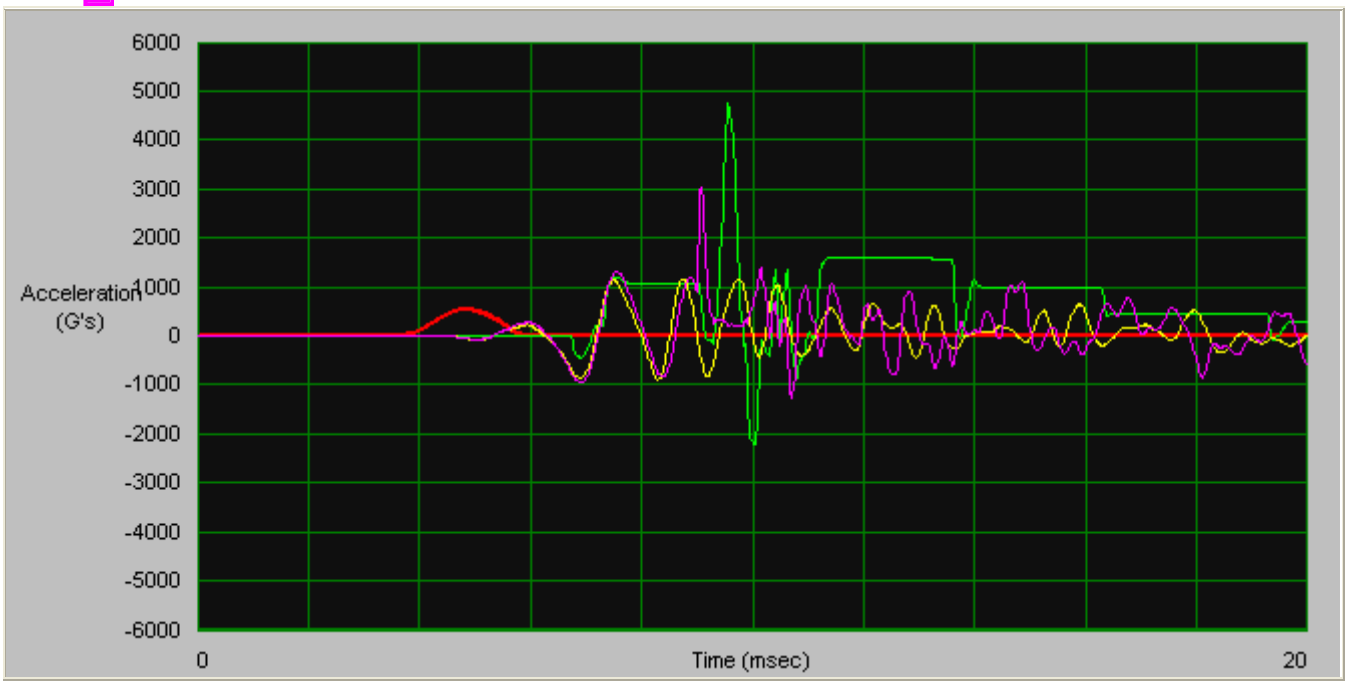
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	852.08	383.04	-698.12	326.78	-	-	-	-
SRS2	Composite	0.05	8252.51	1067.87	-7534.84	1099.16	-	-	-	-
SRS3	Composite	0.05	5123.86	847.57	-4487.89	1099.16	-	-	-	-
SRS4	Composite	0.05	5440.41	625.86	-4127.22	644.20	-	-	-	-



Card 29, 148, 184 – Drop 9

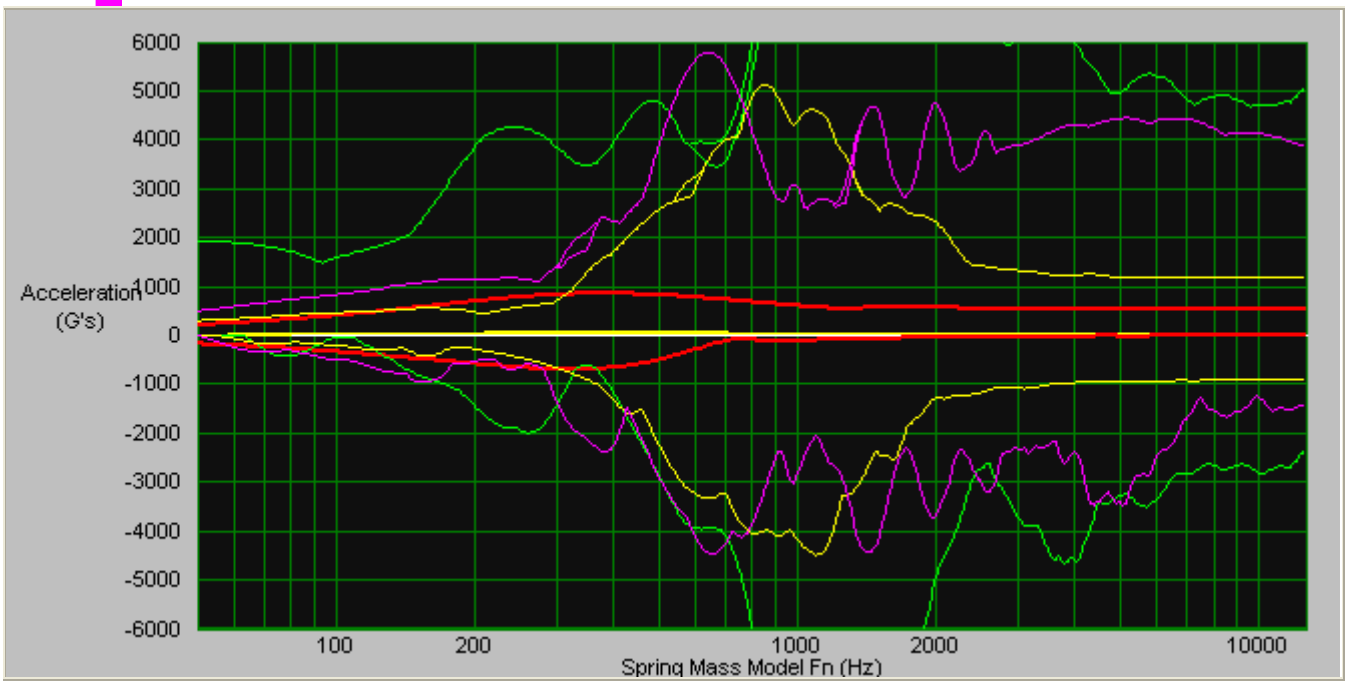
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	539.43	1.92	252.77	1315.79	539.43	-17.17
Ch2	148 (strain gauged)	4753.76	0.44	491.03	4464.29	4753.76	-2219.63
Ch3	29	1160.80	0.48	140.62	3289.47	1160.80	-891.83
Ch4	184	3045.24	0.66	491.87	2551.02	3045.24	-1273.69



Shock Response Spectra

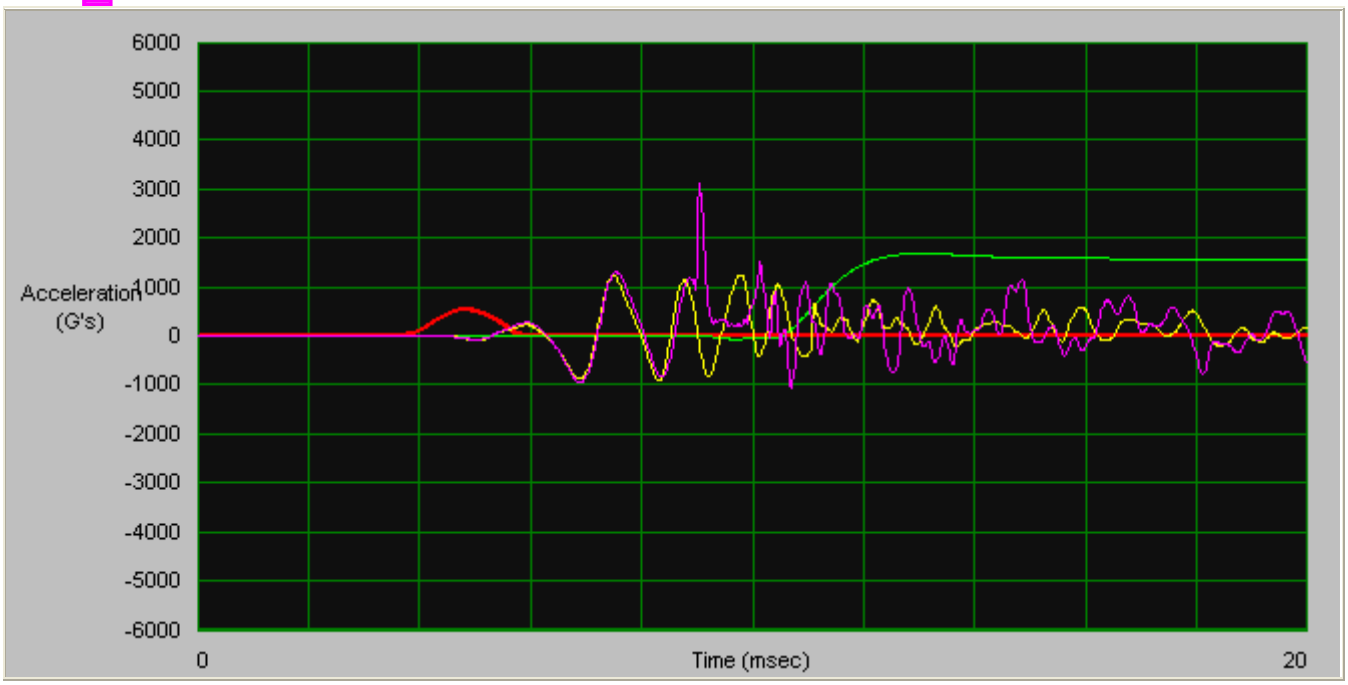
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	849.56	383.04	-698.79	326.78	-	-	-	-
SRS2	Composite	0.05	9227.79	1022.60	-9640.77	1269.92	-	-	-	-
SRS3	Composite	0.05	5117.51	847.57	-4486.63	1099.16	-	-	-	-
SRS4	Composite	0.05	5791.51	644.20	-4460.91	653.57	-	-	-	-



Card 29, 148, 184 – Drop 10

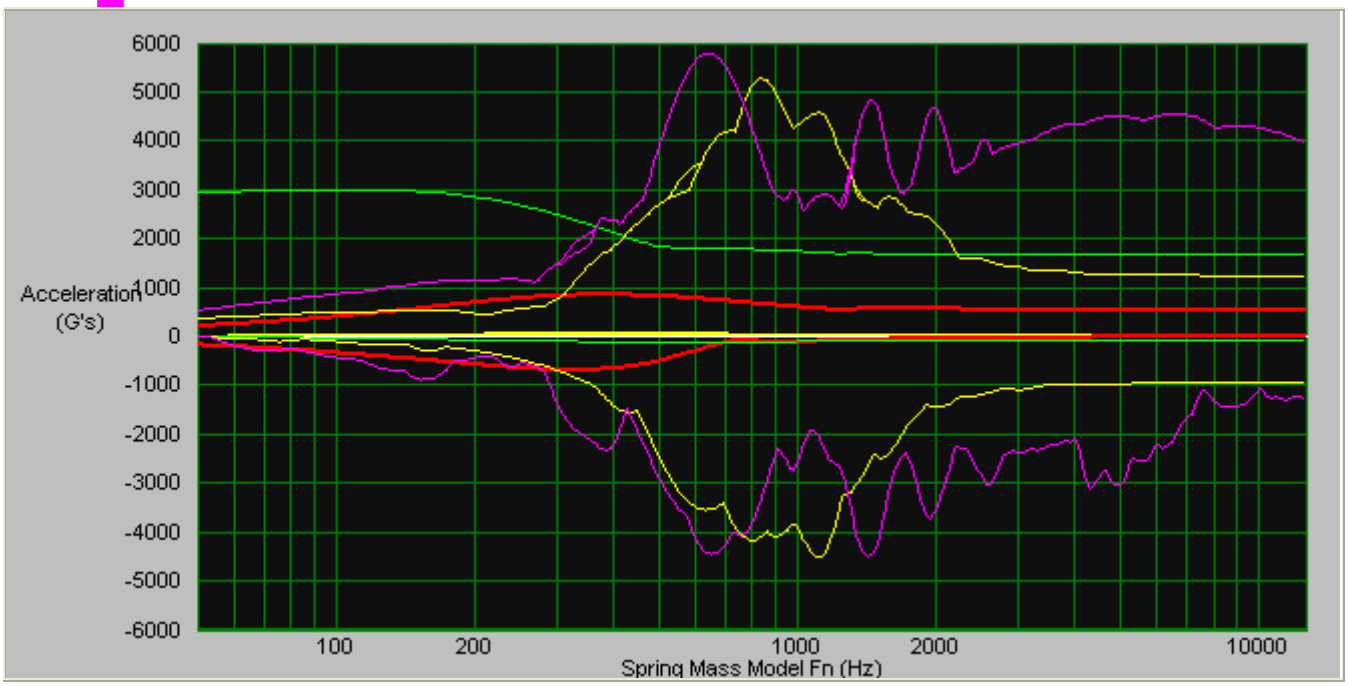
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	540.45	1.90	251.35	1315.79	540.45	-17.60
Ch2	148 (strain gauged)	1680.85	9.28	5361.00	262.05	1680.85	-63.50
Ch3	29	1240.26	0.56	169.65	3289.47	1240.26	-917.40
Ch4	184	3108.61	0.64	491.01	2604.17	3108.61	-1082.80



Shock Response Spectra

	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	847.17	377.55	-690.61	326.78	-	-	-	-
SRS2	Composite	0.05	2999.71	97.15	-111.99	644.20	-	-	-	-
SRS3	Composite	0.05	5266.38	835.42	-4512.09	1115.15	-	-	-	-
SRS4	Composite	0.05	5785.27	644.20	-4495.63	1425.44	-	-	-	-

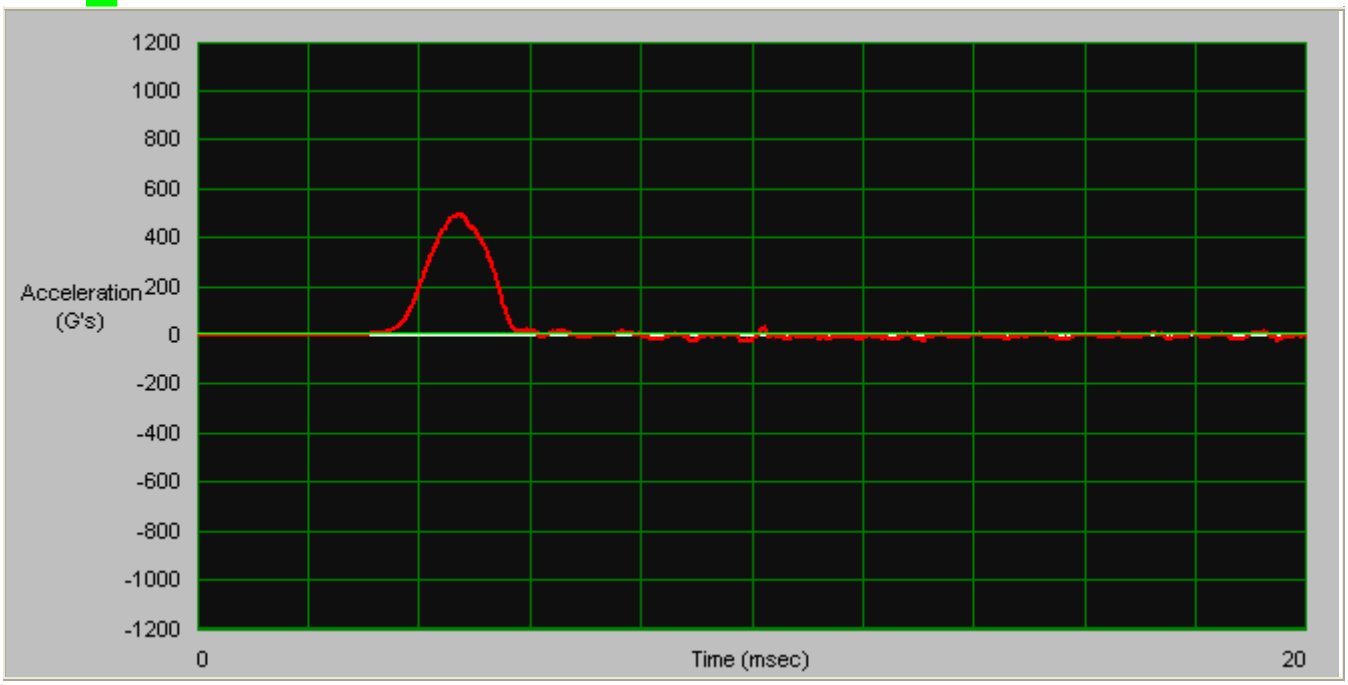


11.7 Set 7 – Card 27, 58 (strain gauged)

Card 27, 58 – Drop 1

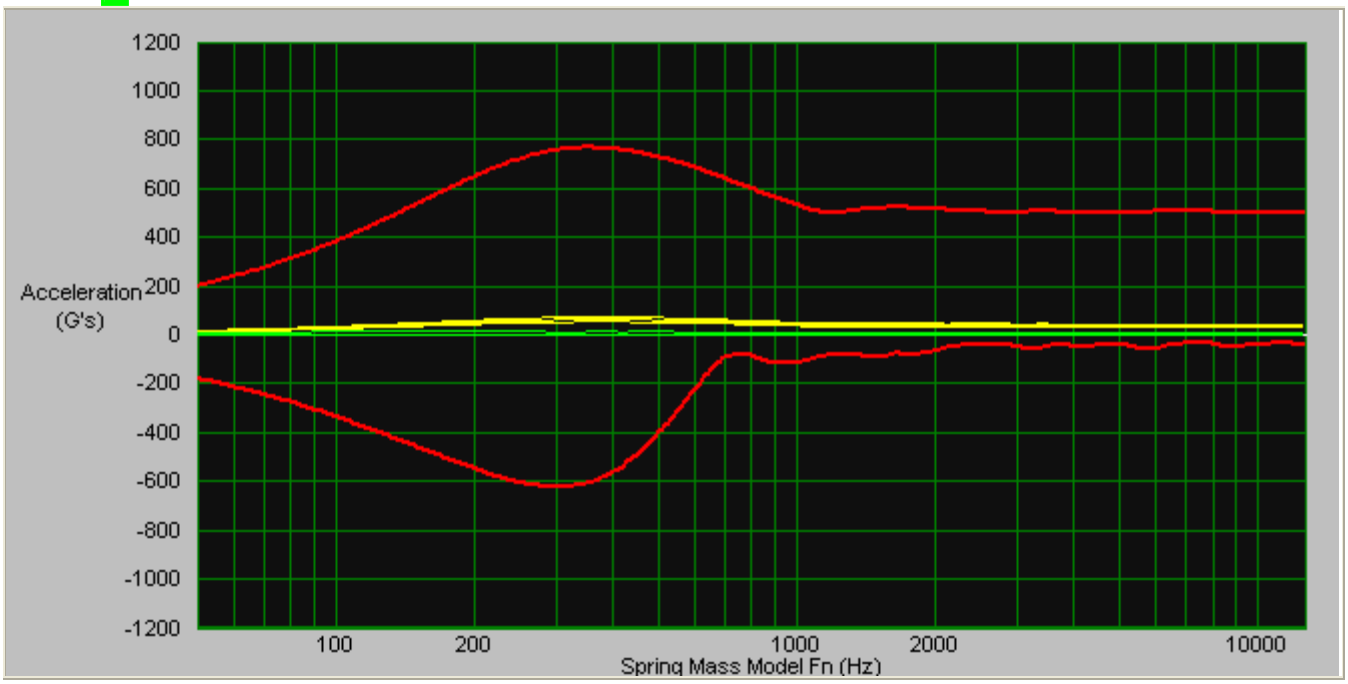
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	496.24	2.00	244.45	4901.96	496.24	-27.42
Ch2	27	7.21	20.00	55.18	500.00	9.15	4.78



Shock Response Spectra

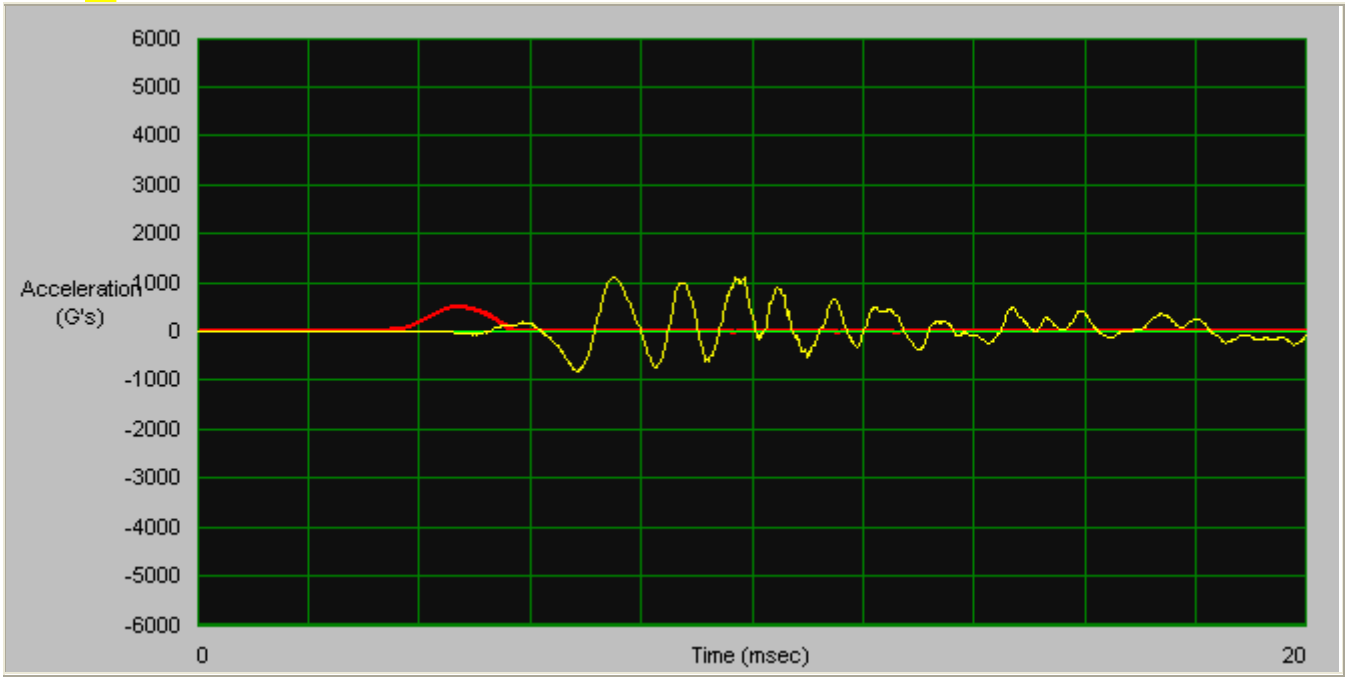
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	766.33	356.36	-622.08	299.66	-	-	-	-
SRS2	Composite	0.05	14.53	156.46	-1.29	165.77	-	-	-	-



Card 27, 58 – Drop 2

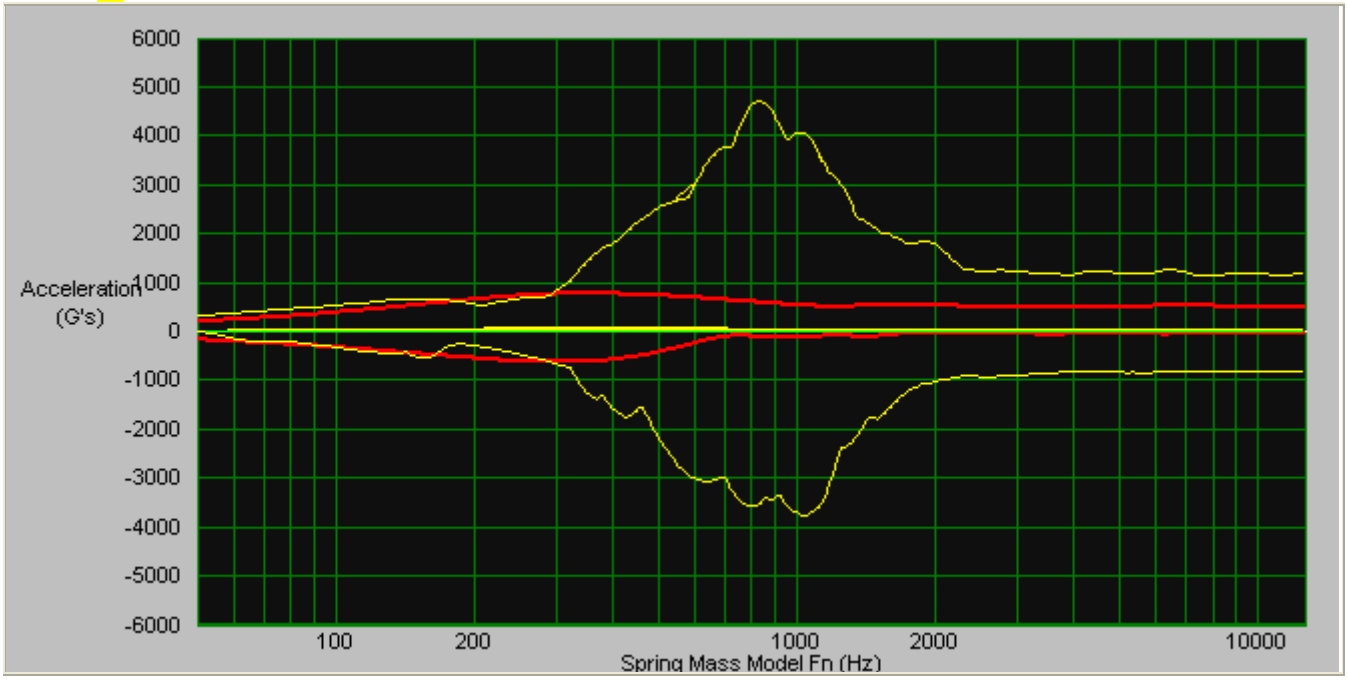
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	493.52	2.00	242.71	4901.96	501.68	-25.05
Ch2	27	4.88	20.00	37.78	500.00	5.32	3.26
Ch3	58 (strain gauged)	814.53	0.64	176.23	12820.51	1106.53	-802.98



Shock Response Spectra

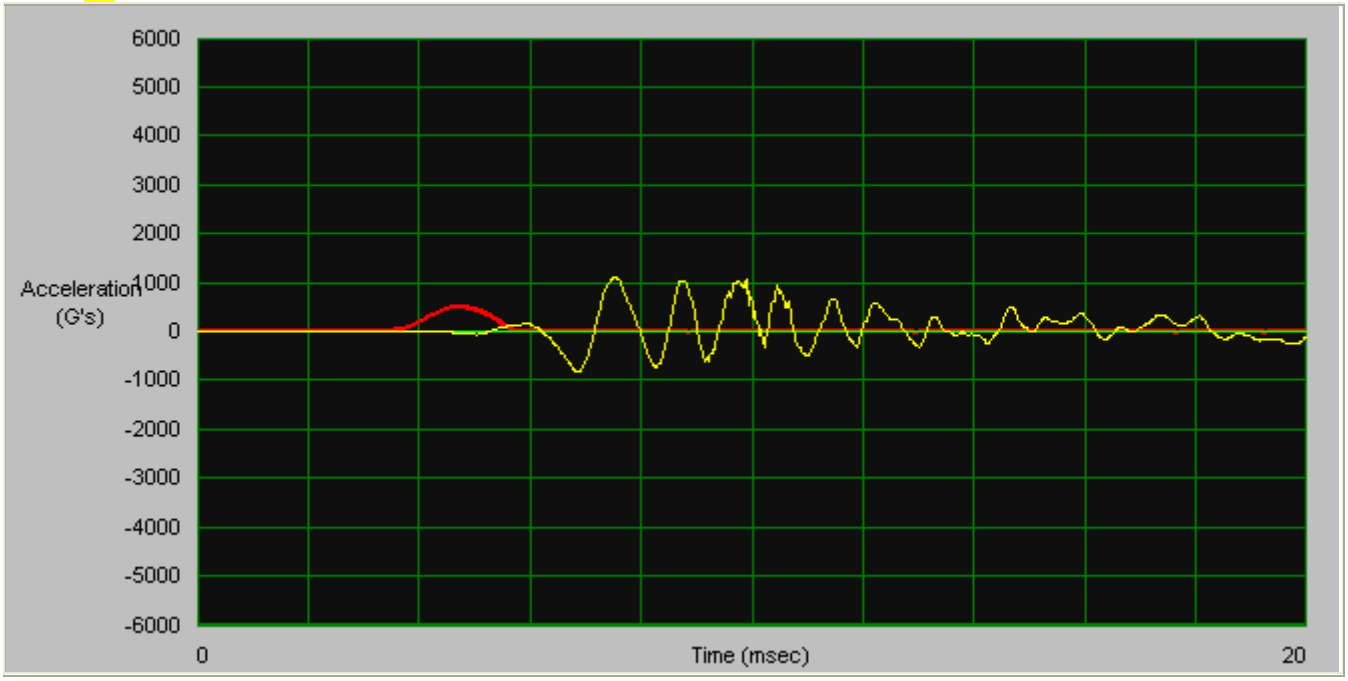
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	768.05	351.25	-633.91	304.02	-	-	-	-
SRS2	Composite	0.05	9.21	131.57	0.00	49.28	-	-	-	-
SRS3	Composite	0.05	4692.21	823.44	-3780.77	1037.47	-	-	-	-



Card 27, 58 – Drop 3

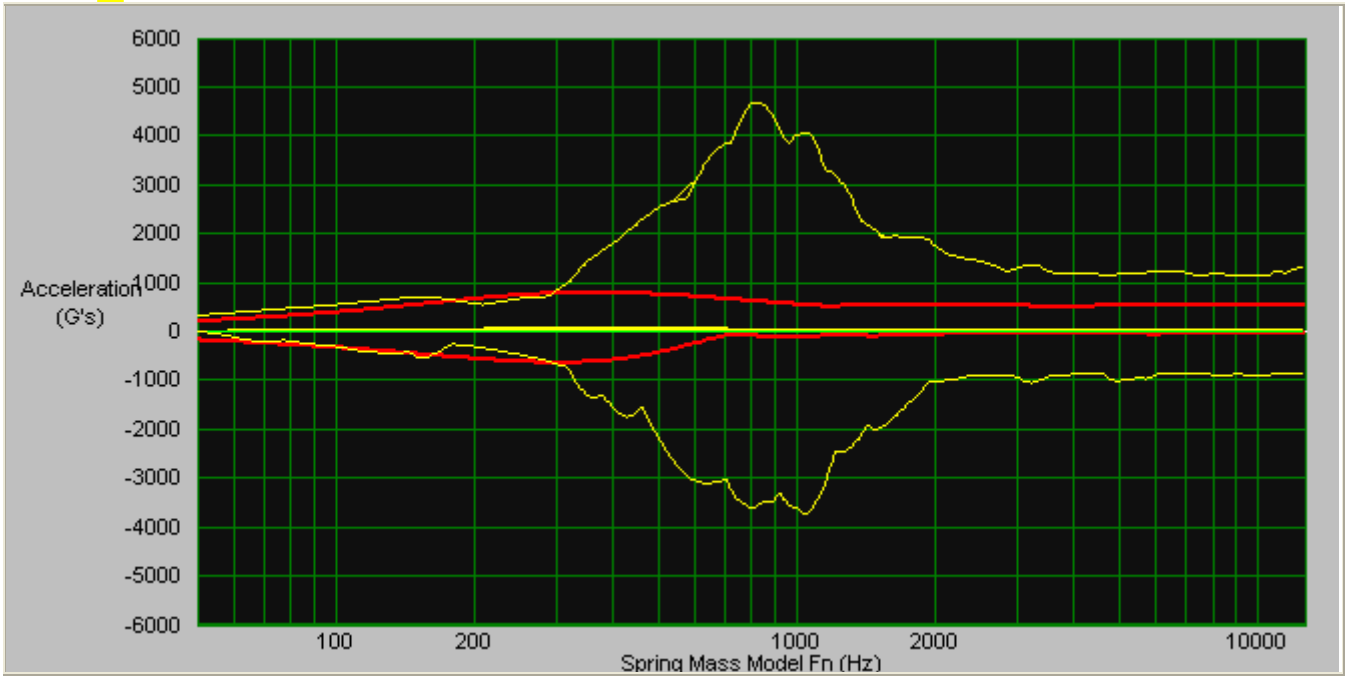
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	501.48	1.98	244.15	4950.50	512.25	-23.69
Ch2	27	4.91	20.00	37.93	500.00	6.10	2.74
Ch3	58 (strain gauged)	1113.09	0.78	211.76	12820.51	1113.09	-834.77



Shock Response Spectra

	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	786.29	356.36	-641.75	304.02	-	-	-	-
SRS2	Composite	0.05	9.48	496.74	-0.89	503.97	-	-	-	-
SRS3	Composite	0.05	4687.42	823.44	-3715.14	1037.47	-	-	-	-



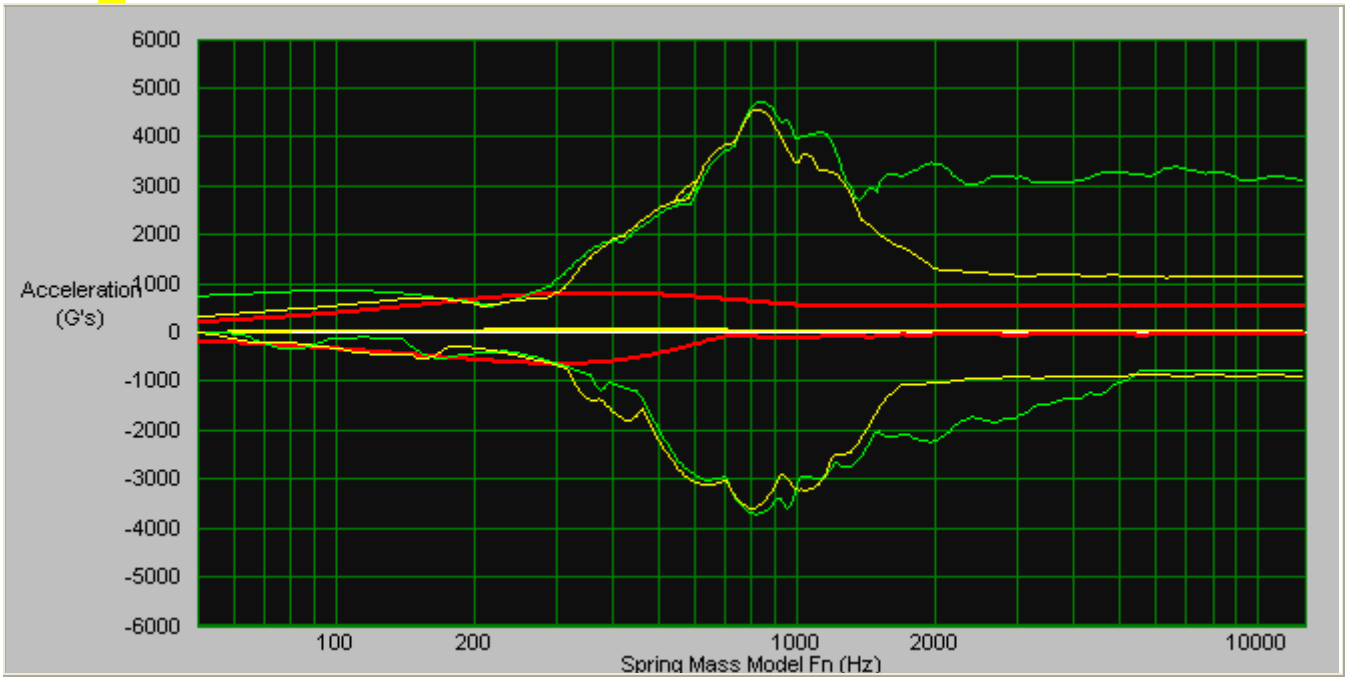
Card 27, 58 – Drop 4

Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	517.78	1.96	246.71	4950.50	517.78	-23.28
Ch2	27	2307.92	0.74	363.98	3703.70	2307.92	-760.12
Ch3	58 (strain gauged)	1127.04	0.78	210.29	12820.51	1127.04	-863.52

Shock Response Spectra

	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	797.45	361.54	-646.99	304.02	-	-	-	-
SRS2	Composite	0.05	4712.14	835.42	-3717.98	823.44	-	-	-	-
SRS3	Composite	0.05	4549.07	823.44	-3603.31	800.00	-	-	-	-



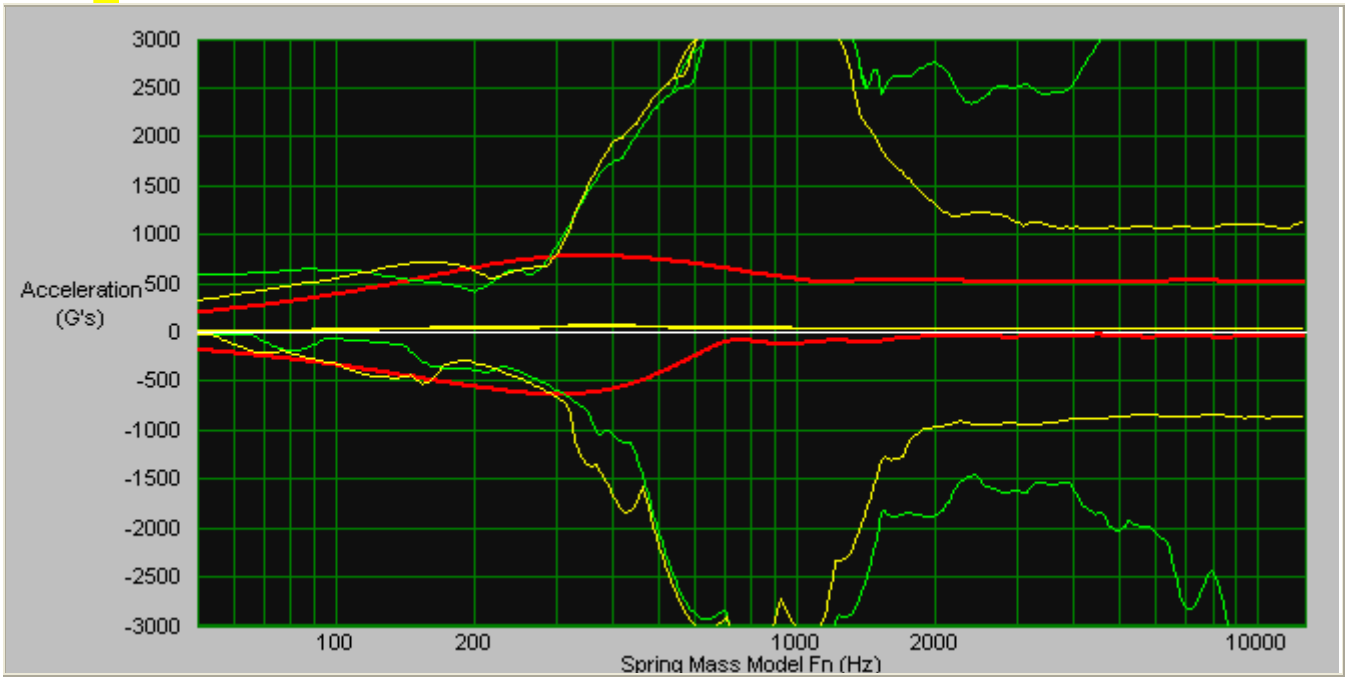
Card 27, 58 – Drop 5

Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	499.39	1.98	244.55	4901.96	507.77	-23.20
Ch2	27	4134.17	0.16	80.22	12820.51	4134.17	-802.55
Ch3	58 (strain gauged)	1047.26	0.78	203.42	12820.51	1047.26	-838.92

Shock Response Spectra

	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	779.19	351.25	-634.73	304.02	-	-	-	-
SRS2	Composite	0.05	4509.66	11403.50	-3834.12	11908.38	-	-	-	-
SRS3	Composite	0.05	4453.74	823.44	-3422.52	800.00	-	-	-	-



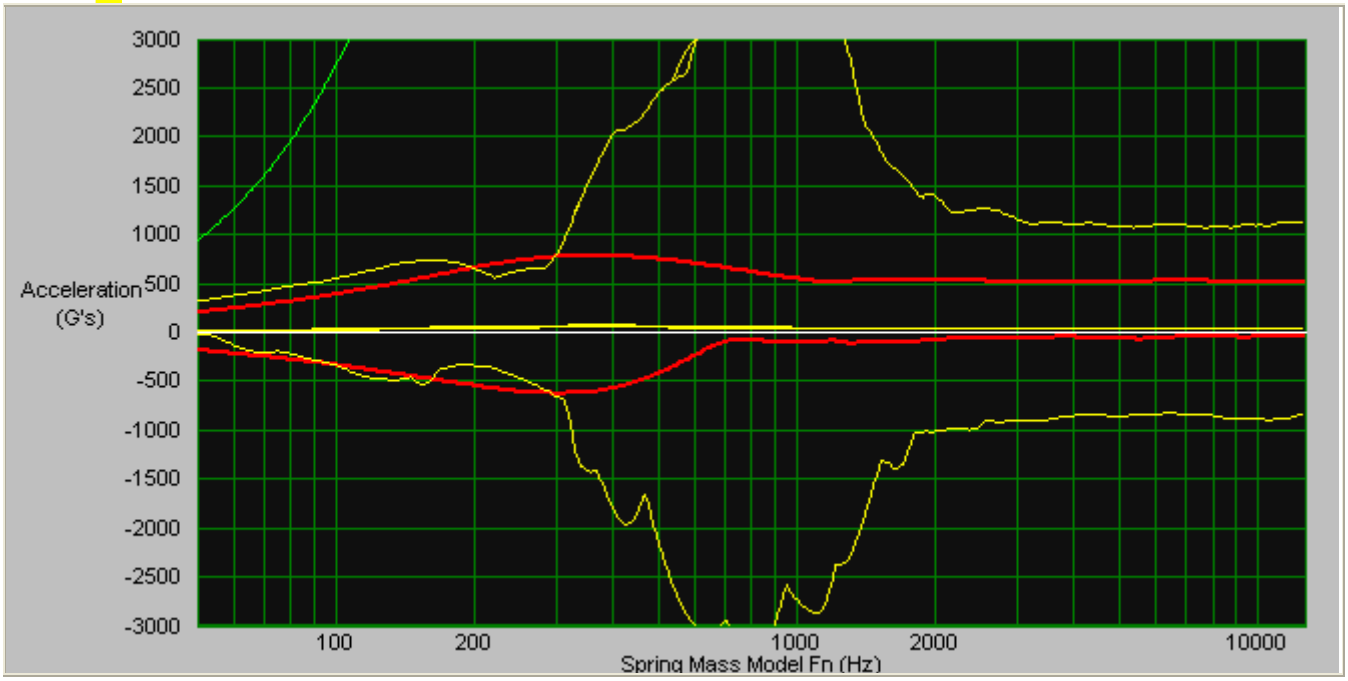
Card 27, 58 – Drop 6

Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	502.02	1.98	247.16	4901.96	511.48	-40.83
Ch2	27	10000.11	0.66	2387.81	11904.76	10002.82	-2448.72
Ch3	58 (strain gauged)	1069.32	0.78	203.74	12820.51	1069.32	-828.88

Shock Response Spectra

	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	782.44	356.36	-625.02	304.02	-	-	-	-
SRS2	Composite	0.05	21070.70	723.09	-21039.04	723.09	-	-	-	-
SRS3	Composite	0.05	4492.66	823.44	-3436.44	800.00	-	-	-	-



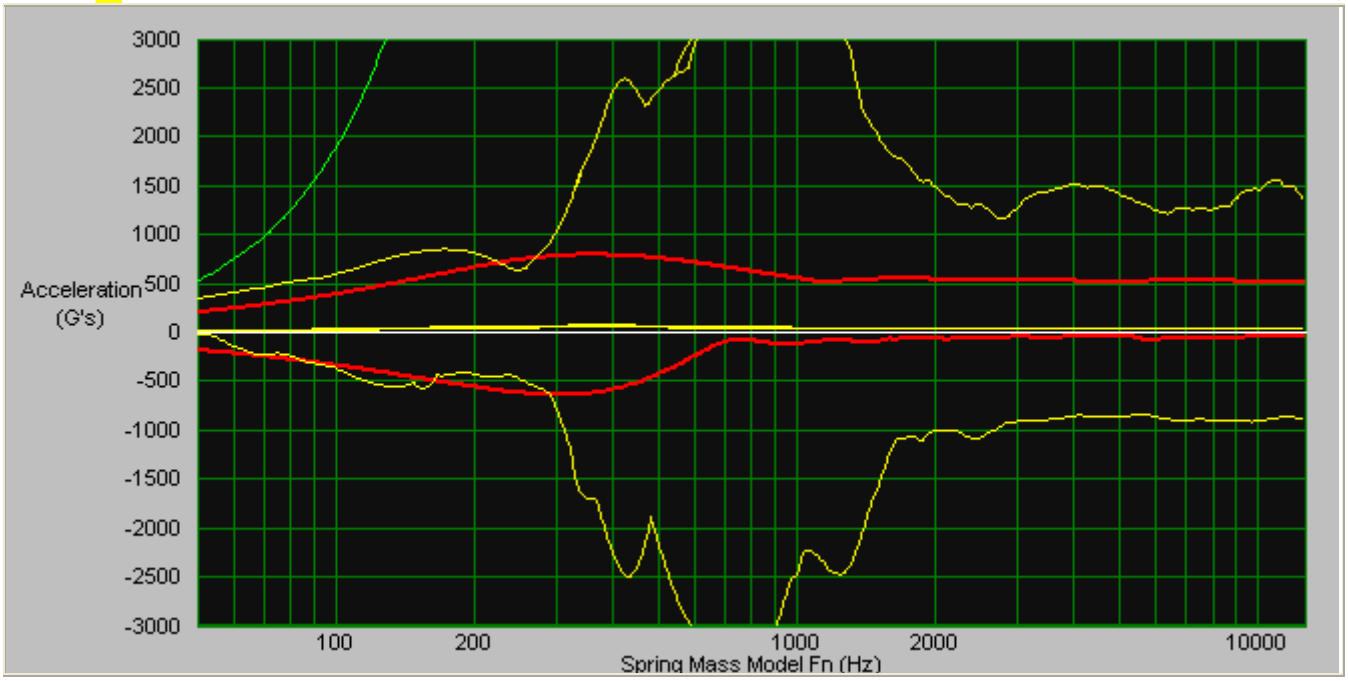
Card 27, 58 – Drop 7

Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	508.00	1.96	248.32	4950.50	515.30	-29.77
Ch2	27	10000.10	0.72	2617.37	11904.76	10002.96	-8690.52
Ch3	58 (strain gauged)	814.95	1.06	317.34	8928.57	1193.43	-848.20

Shock Response Spectra

	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	791.40	356.36	-638.17	304.02	-	-	-	-
SRS2	Composite	0.05	21195.57	744.27	-32438.57	712.72	-	-	-	-
SRS3	Composite	0.05	4801.31	788.53	-3957.05	733.60	-	-	-	-



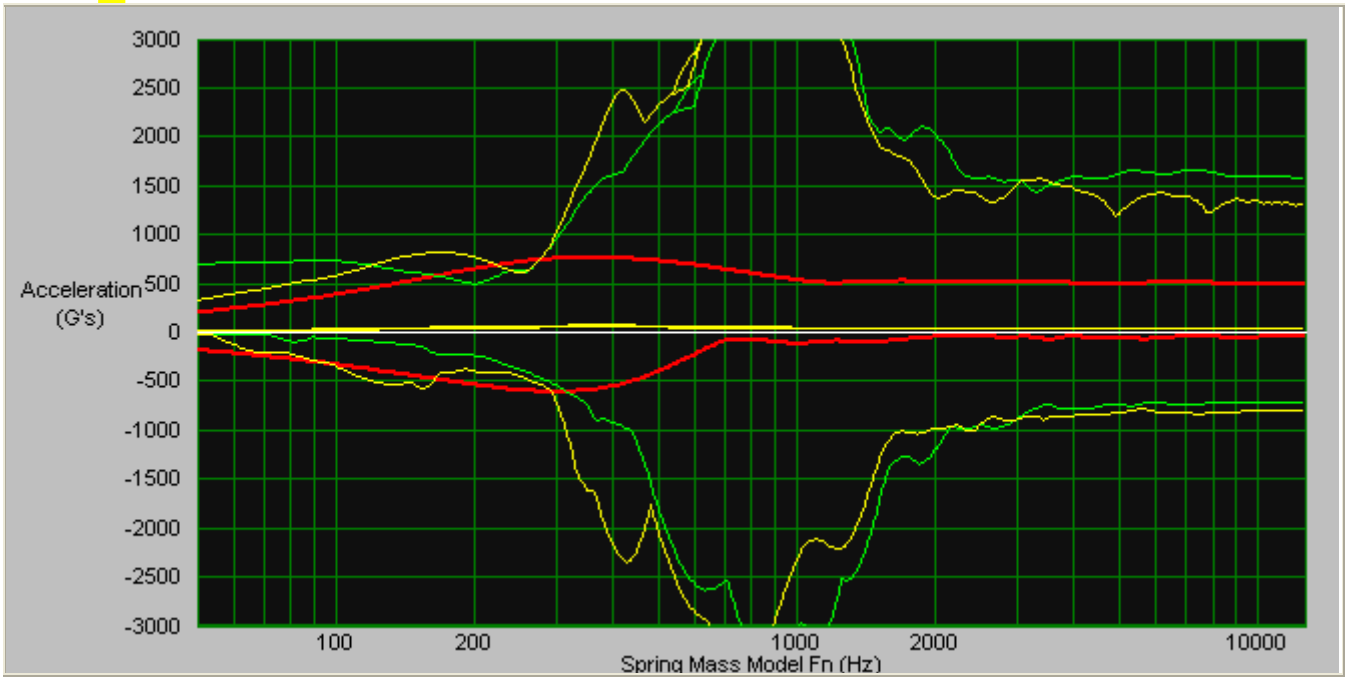
Card 27, 58 – Drop 8

Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	497.75	2.02	244.54	4807.69	497.75	-41.24
Ch2	27	1409.95	3.50	582.12	2793.30	1409.95	-703.73
Ch3	58 (strain gauged)	1230.30	1.16	317.11	8474.58	1230.30	-780.84

Shock Response Spectra

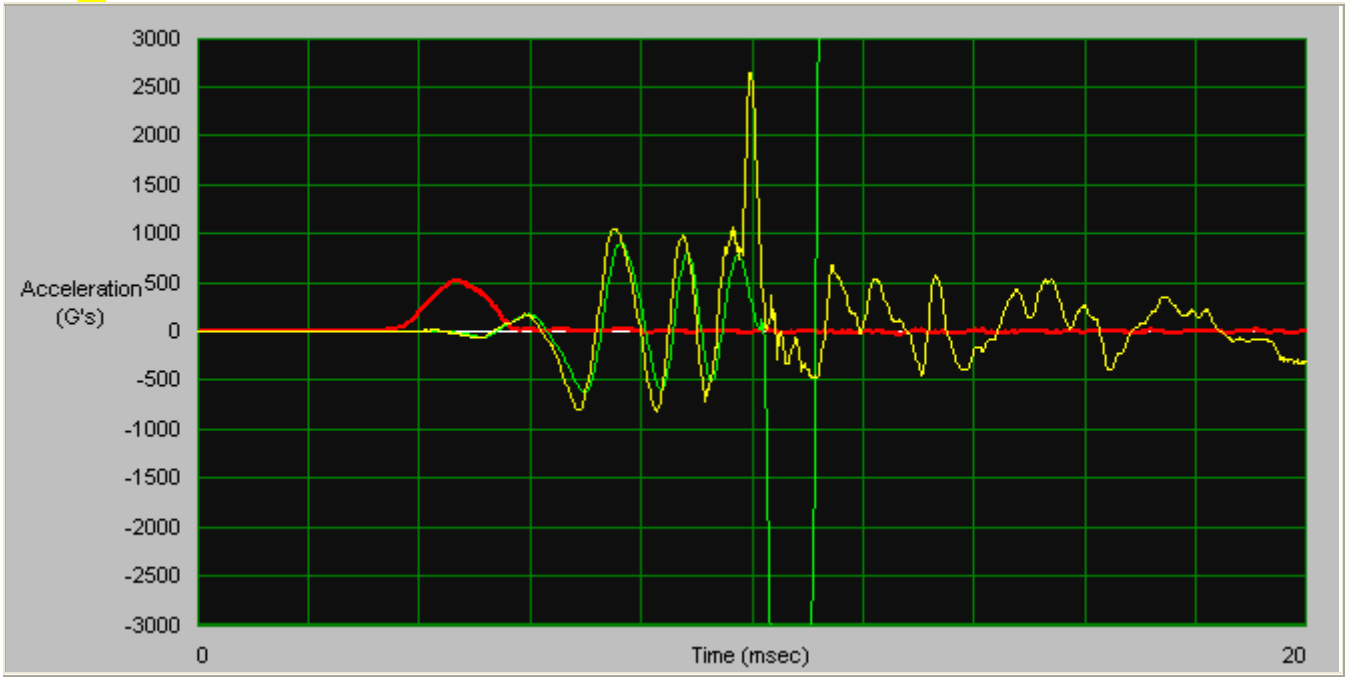
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	764.02	361.54	-608.93	295.37	-	-	-	-
SRS2	Composite	0.05	4144.20	872.41	-3277.97	835.42	-	-	-	-
SRS3	Composite	0.05	4294.30	800.00	-3594.68	723.09	-	-	-	-



Card 27, 58 – Drop 9

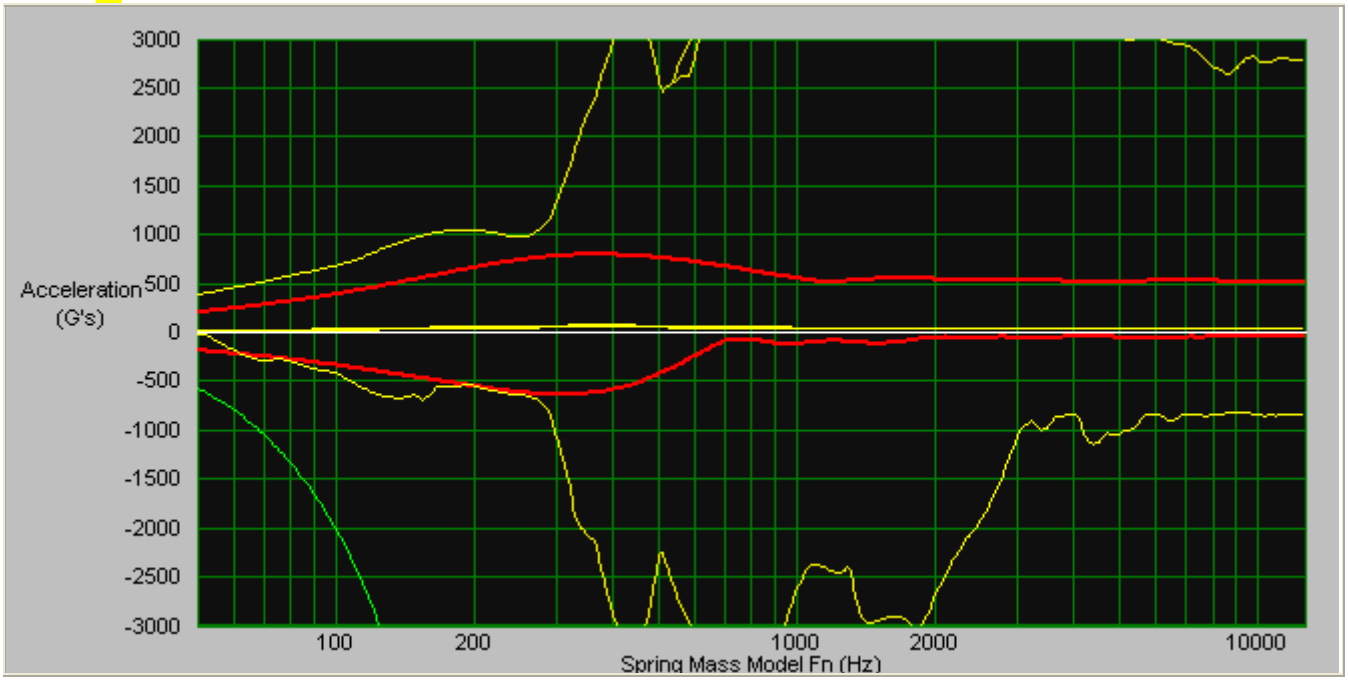
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	517.35	1.94	245.16	4950.50	517.35	-35.58
Ch2	27	10591.32	8.86	33899.89	1126.13	10591.32	-10299.49
Ch3	58 (strain gauged)	2644.26	0.82	385.16	10416.67	2644.26	-814.45



Shock Response Spectra

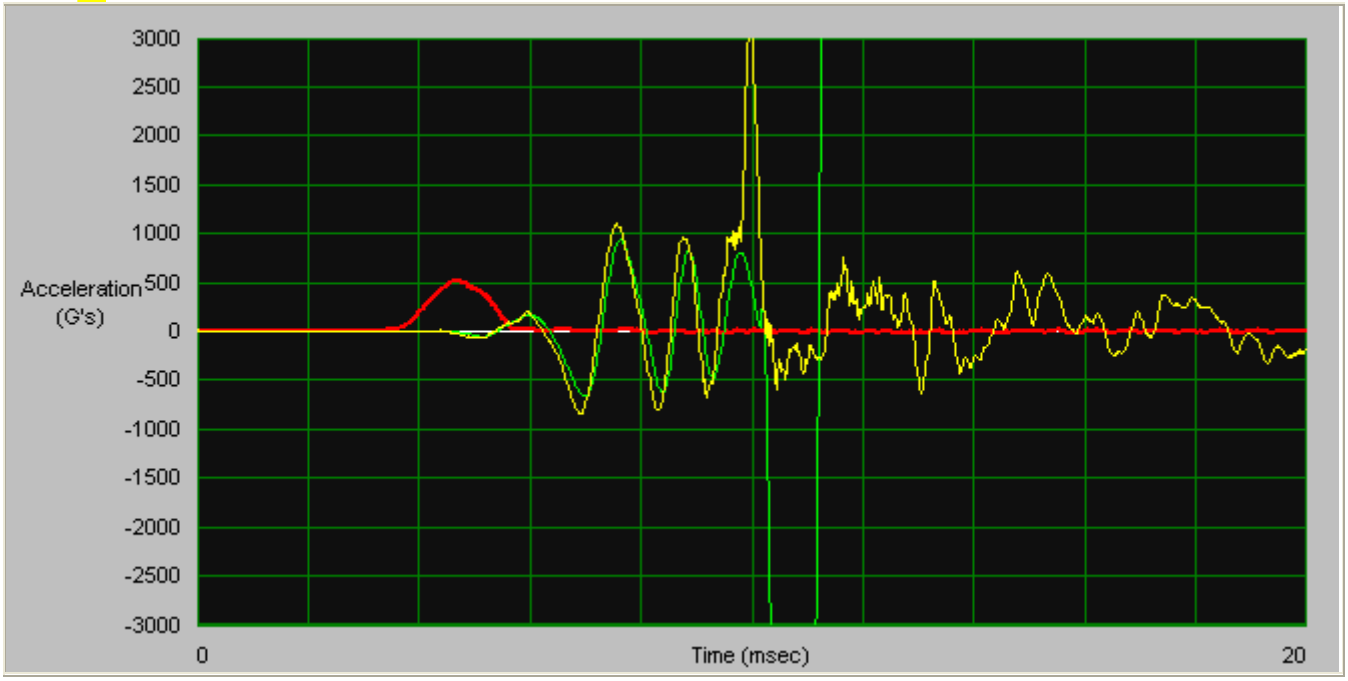
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	792.82	361.54	-635.22	304.02	-	-	-	-
SRS2	Composite	0.05	33672.18	482.60	-19617.93	733.60	-	-	-	-
SRS3	Composite	0.05	5857.54	777.23	-5156.37	766.08	-	-	-	-



Card 27, 58 – Drop 10

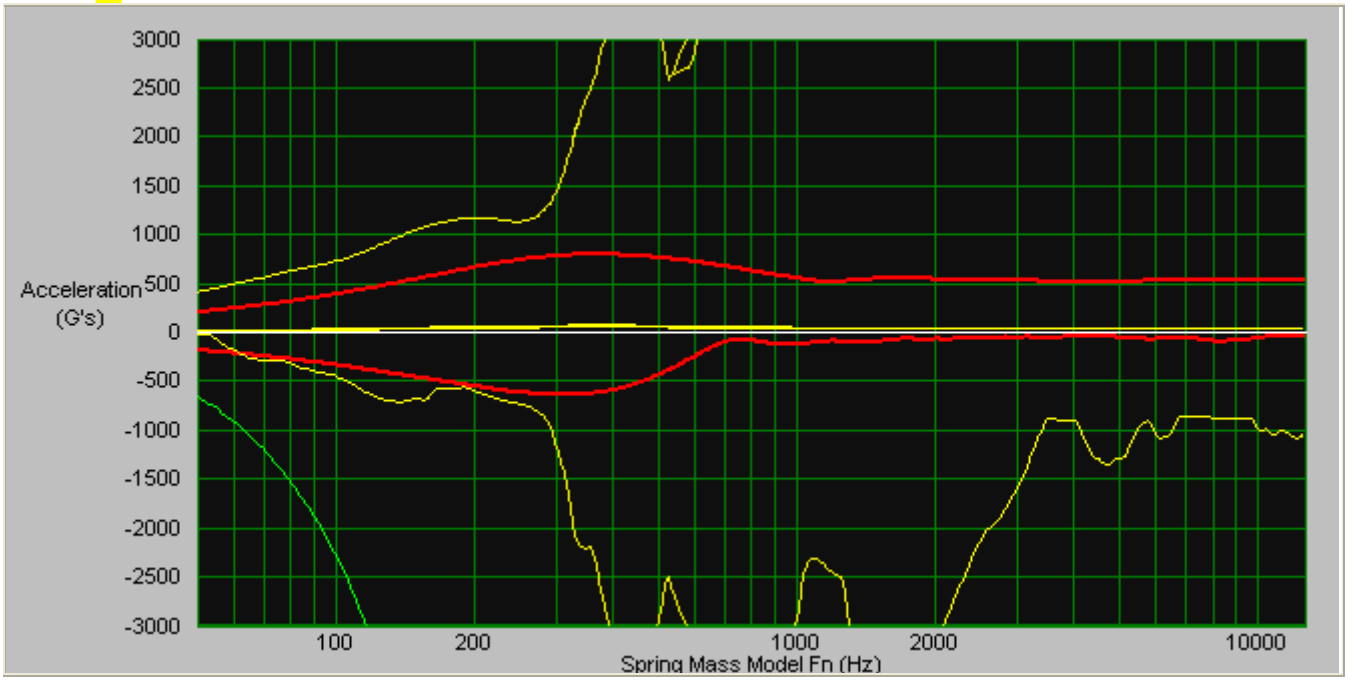
Acceleration vs Time

	Channel Description:	G's	msec	In/S	Filter Hz	Max G's	Min G's
Ch1	Table	511.37	1.96	247.13	5000.00	520.50	-29.14
Ch2	27	10009.37	8.78	33647.95	1136.36	10587.72	-10302.03
Ch3	58 (strain gauged)	1628.52	0.80	437.15	11363.64	3221.44	-847.14



Shock Response Spectra

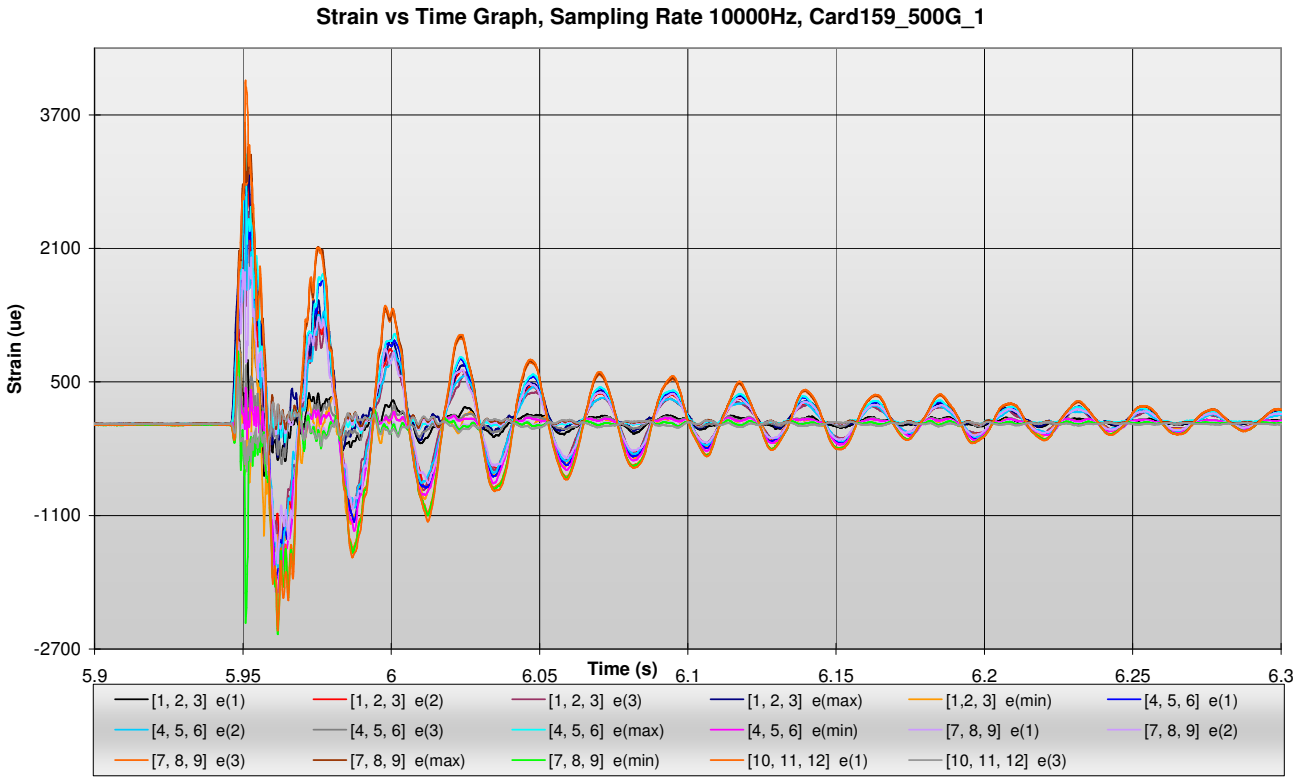
	SRS Type	Damping	Max Accel (G's)	Fn at Max (Hz)	Min Accel (G's)	Fn at Min (Hz)	Marker Fn (Hz)	Abs Accel (G's)	Max Accel (G's)	Min Accel (G's)
SRS1	Composite	0.05	793.82	366.80	-638.15	312.93	-	-	-	-
SRS2	Composite	0.05	34200.07	468.86	-19966.87	733.60	-	-	-	-
SRS3	Composite	0.05	6641.38	788.53	-6229.77	788.53	-	-	-	-



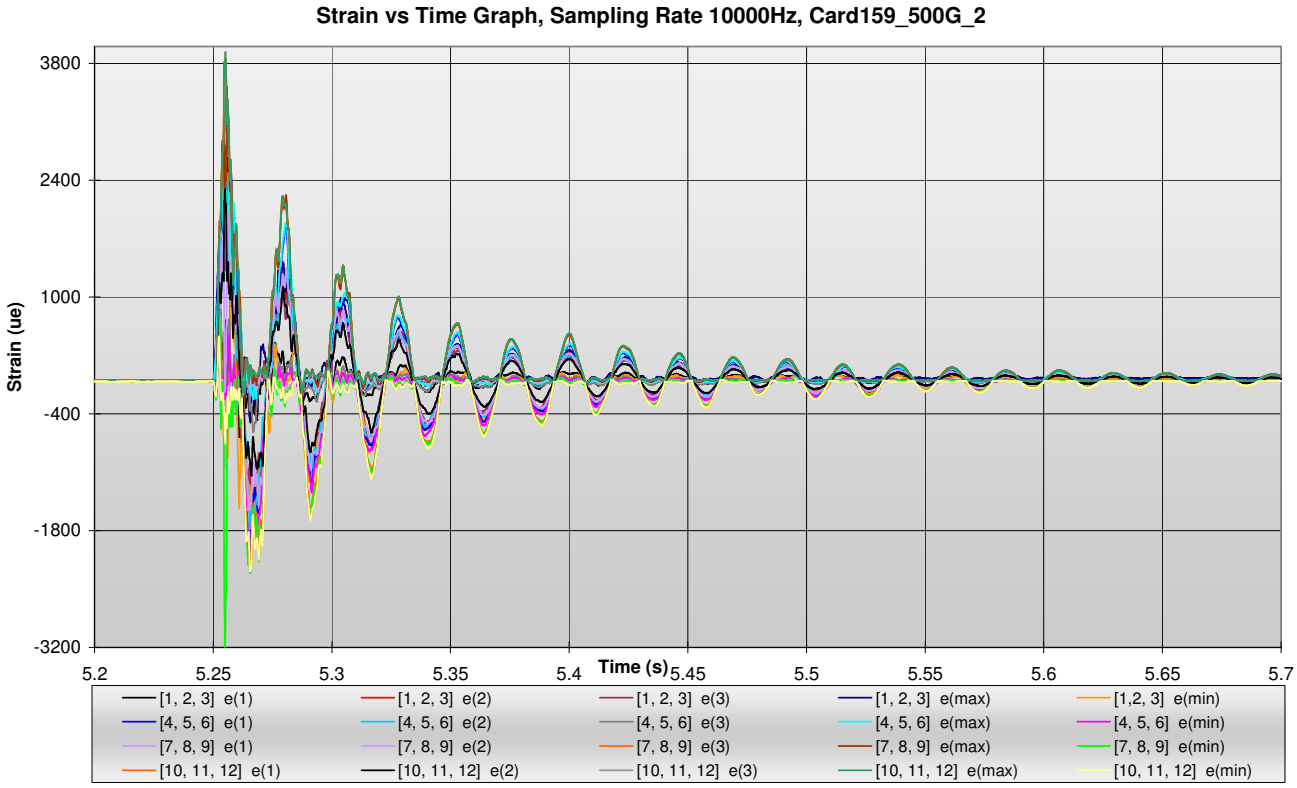
12. APPENDIX C: Strain vs Time

12.1 Set 1 – Card 159

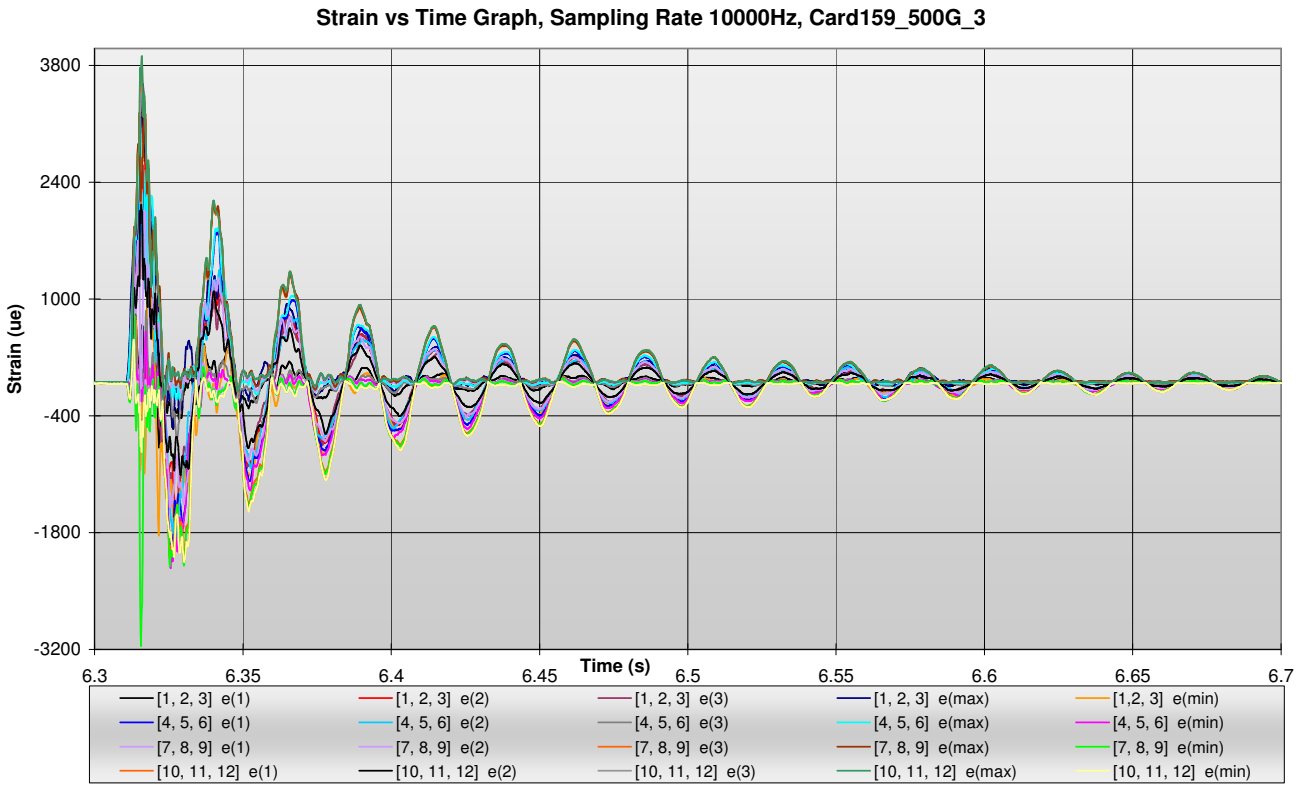
Card 159 - Drop 1



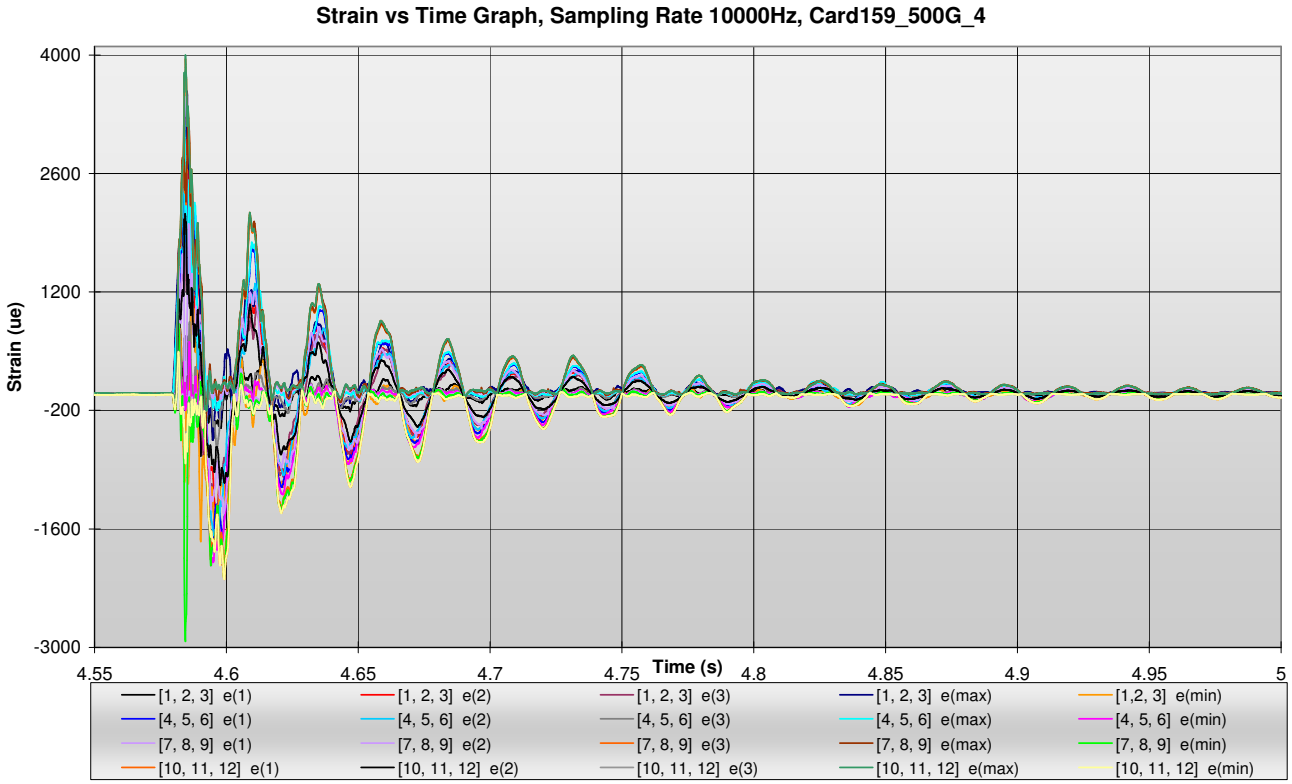
Card 159 - Drop 2



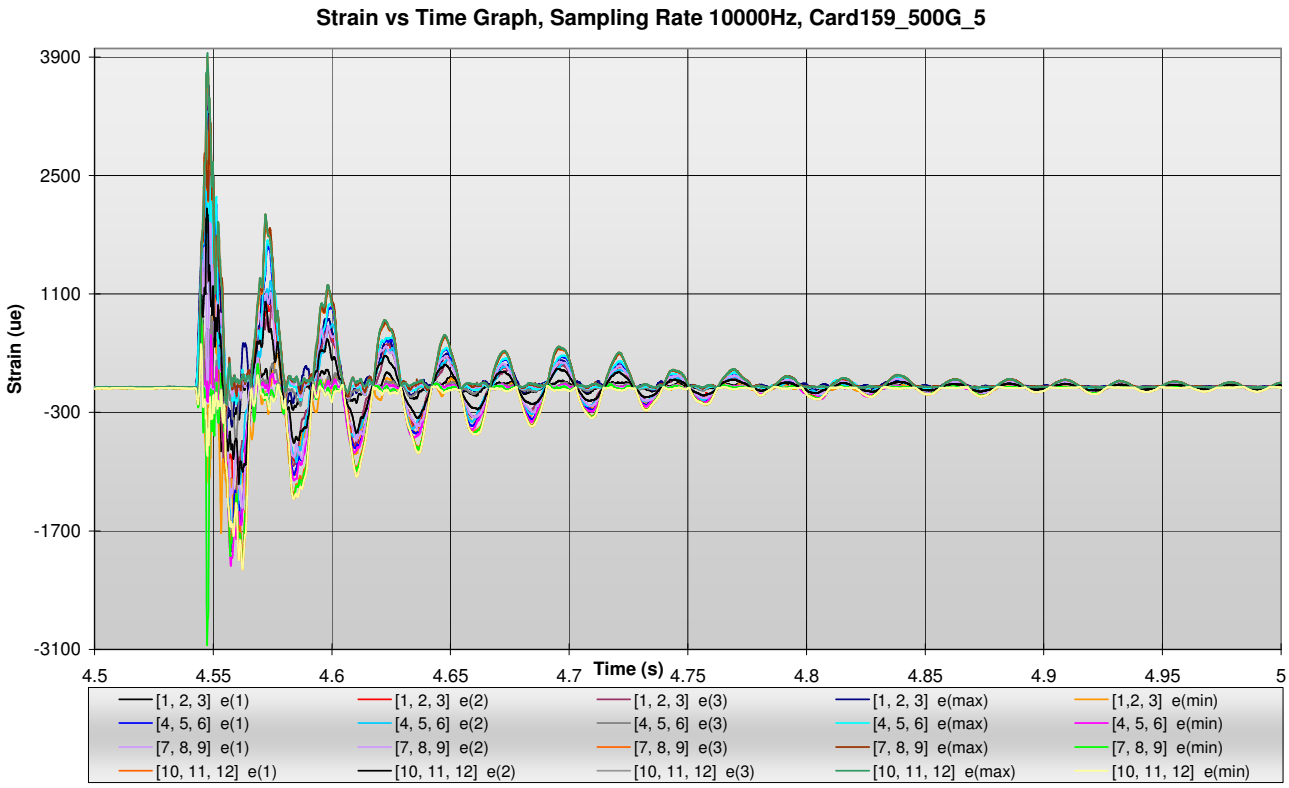
Card 159 - Drop 3



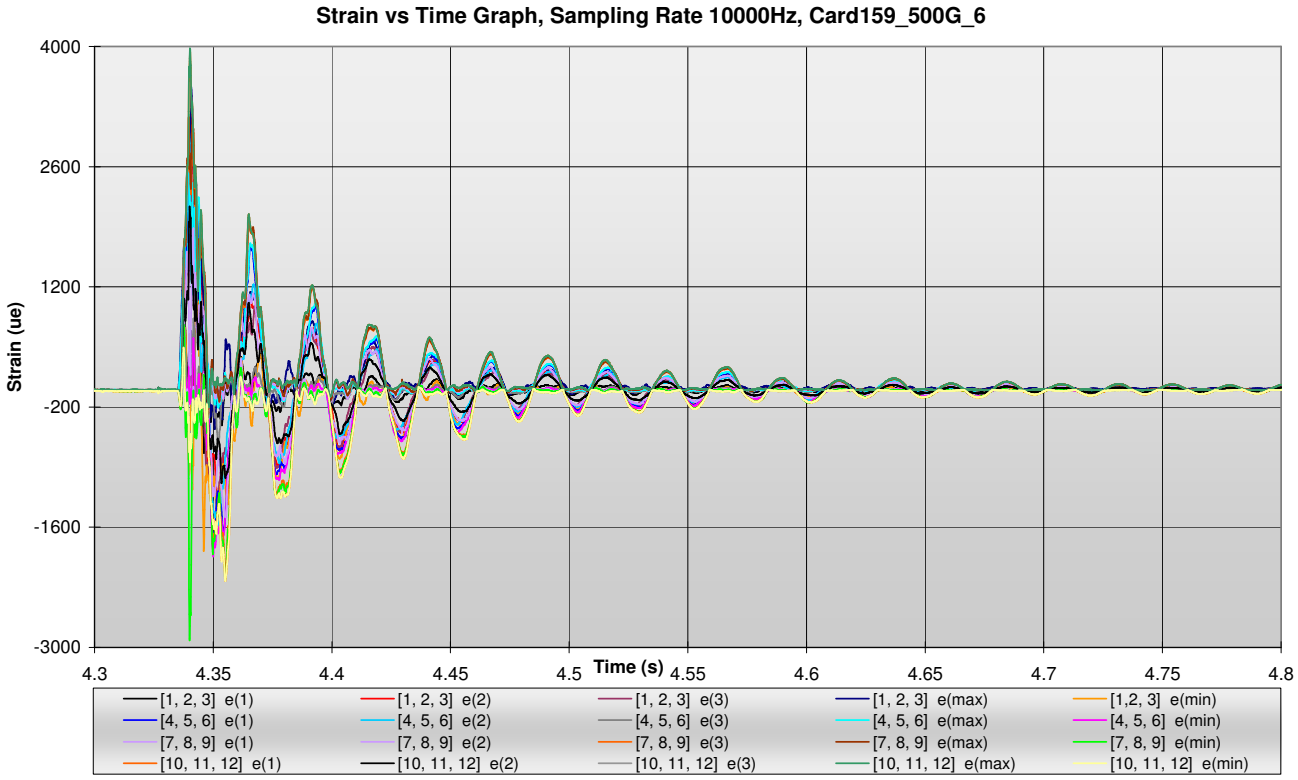
Card 159 - Drop 4



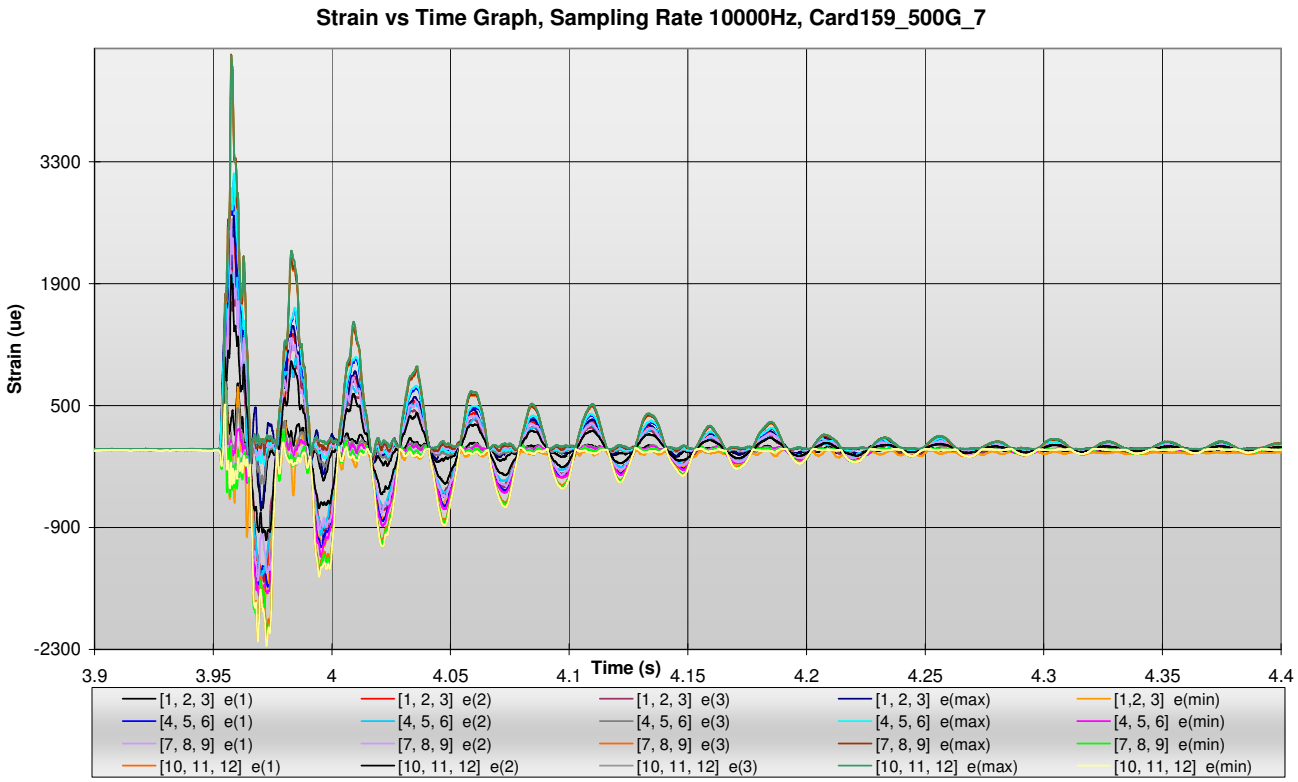
Card 159 - Drop 5



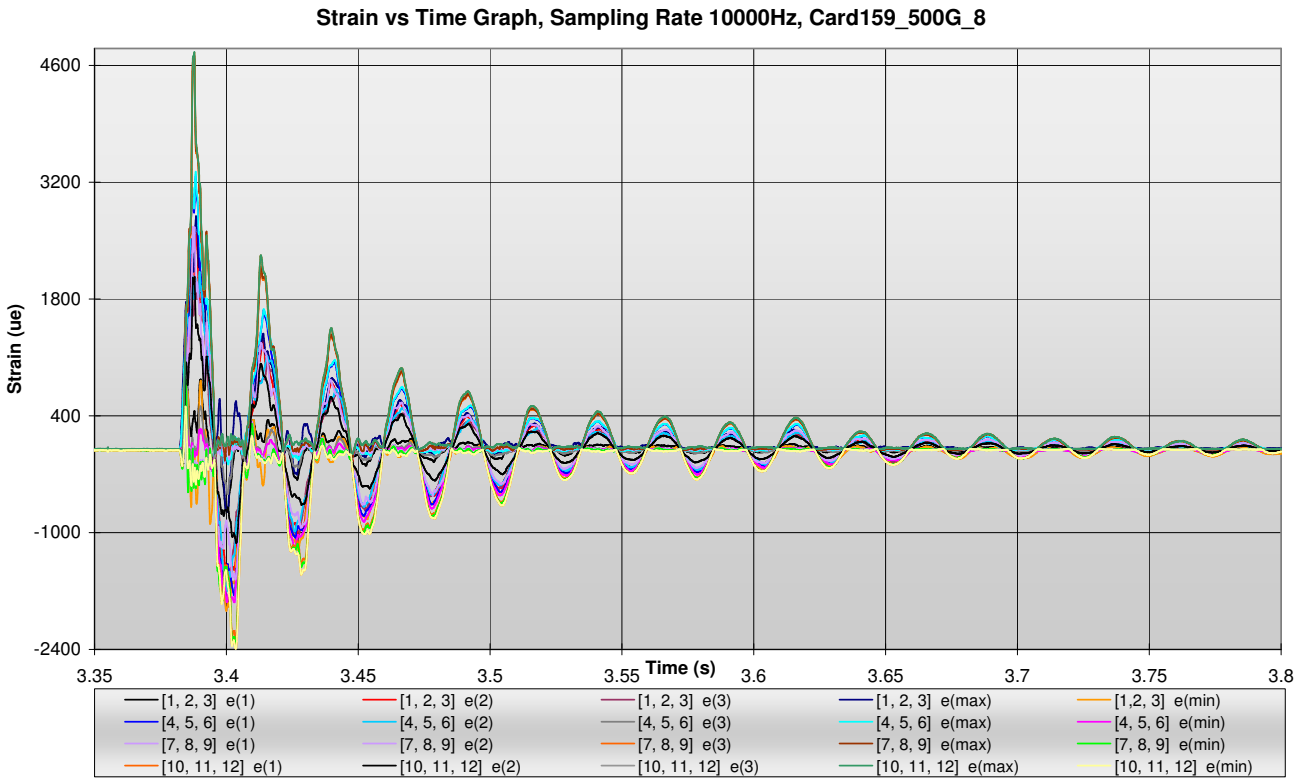
Card 159 - Drop 6



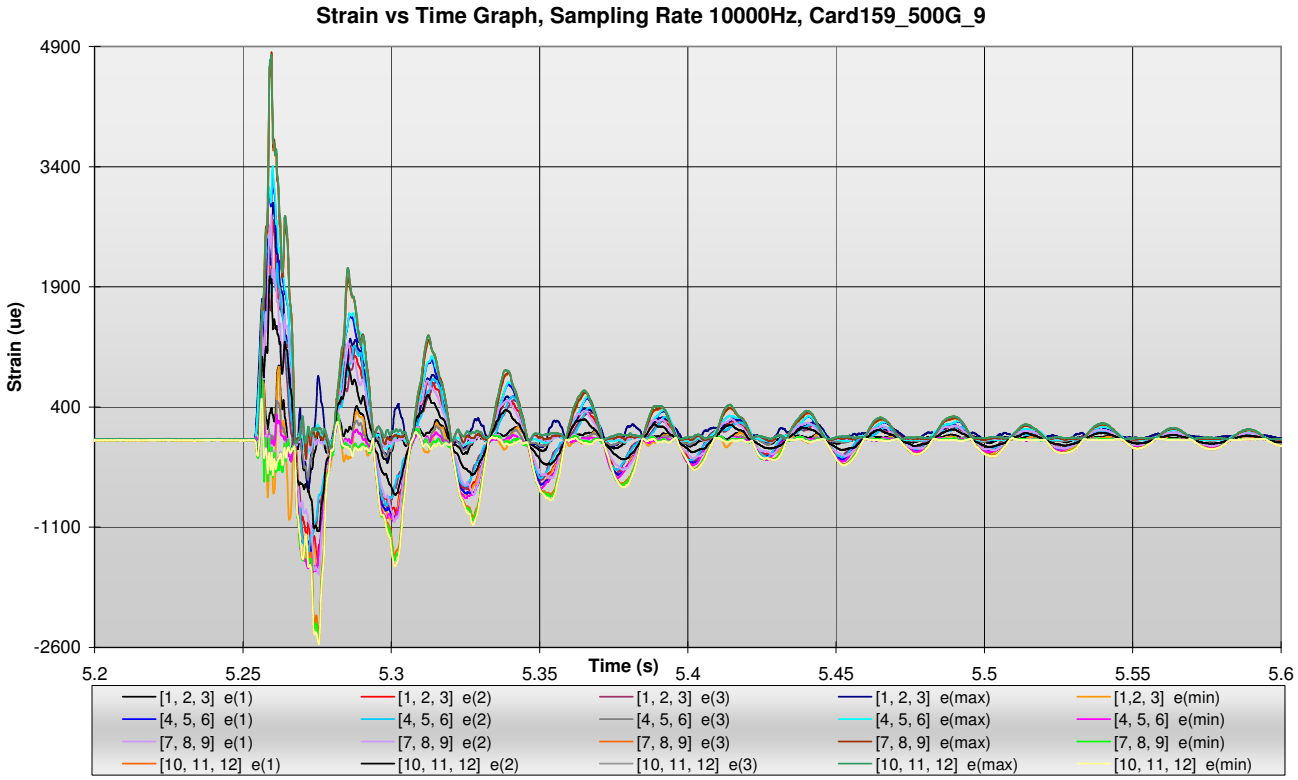
Card 159 - Drop 7



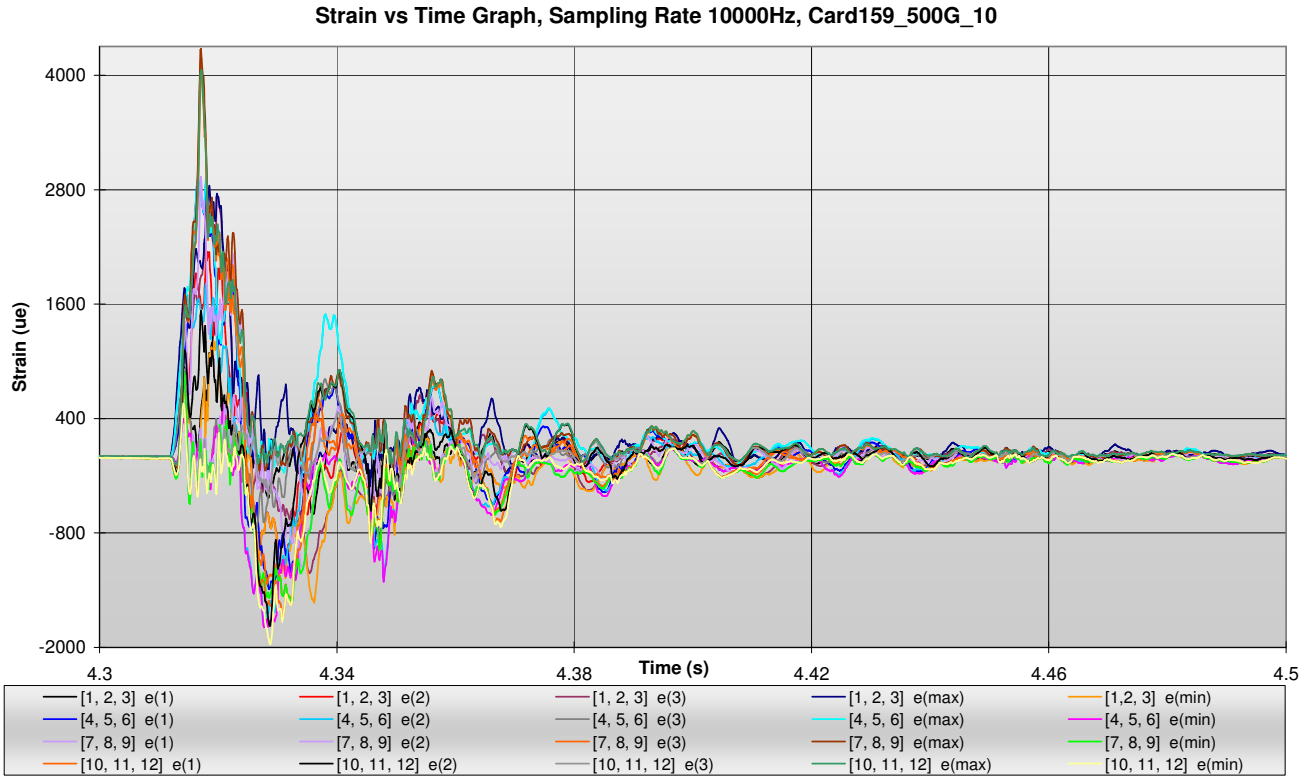
Card 159 - Drop 8



Card 159 - Drop 9

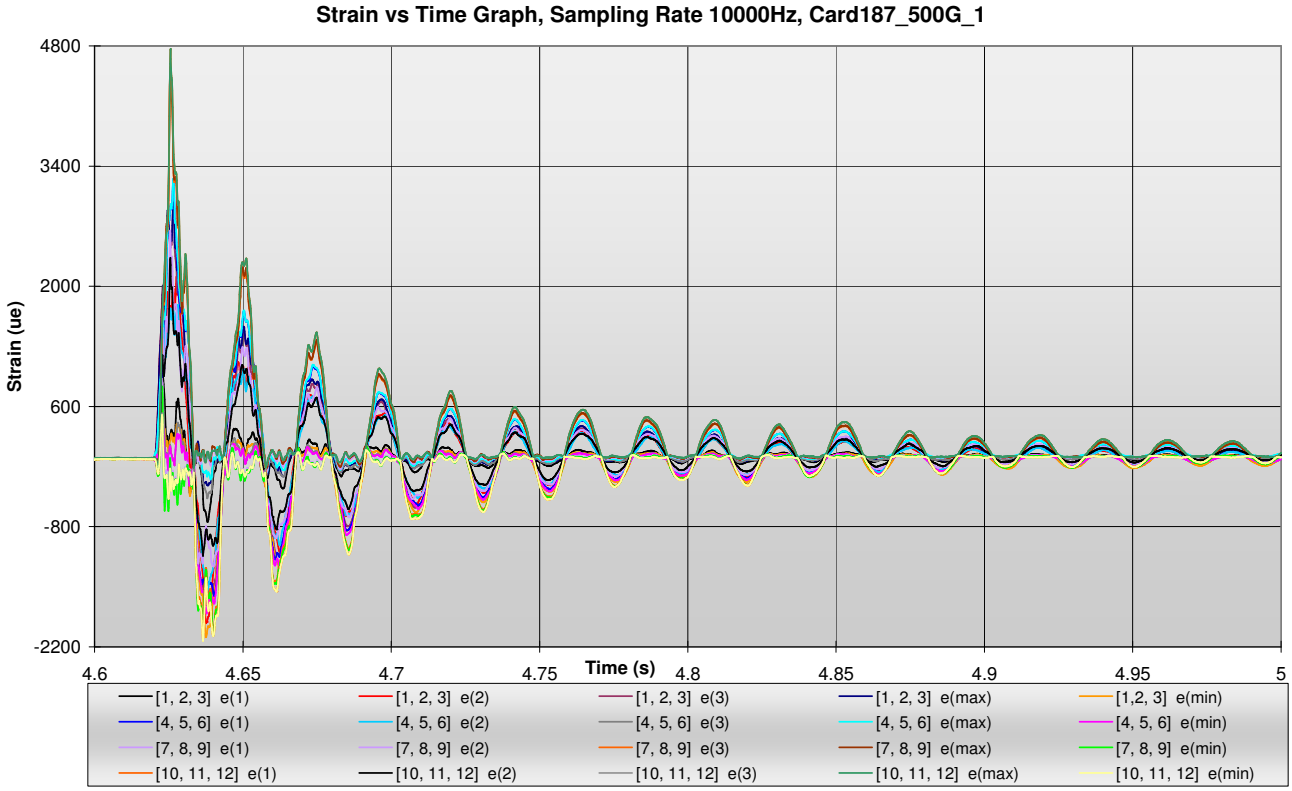


Card 159 - Drop 10

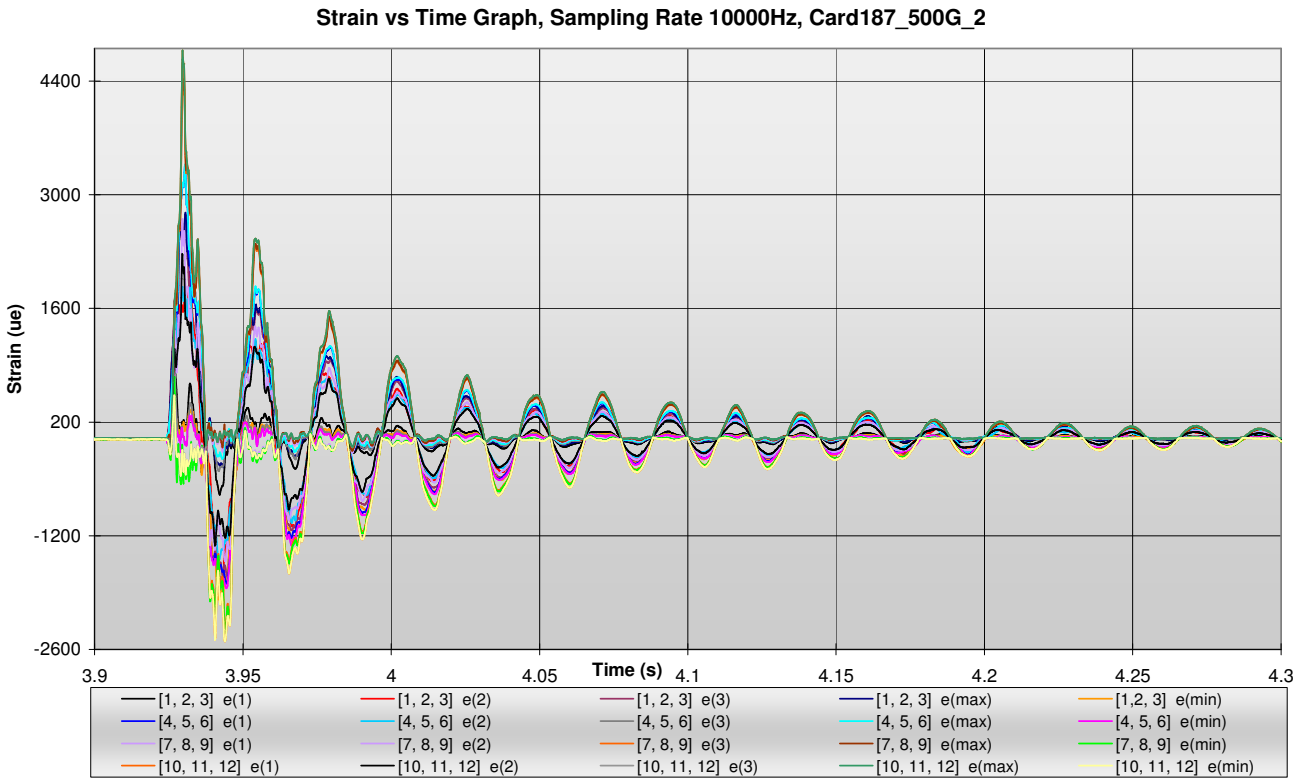


12.2 Set 2 – Card 187

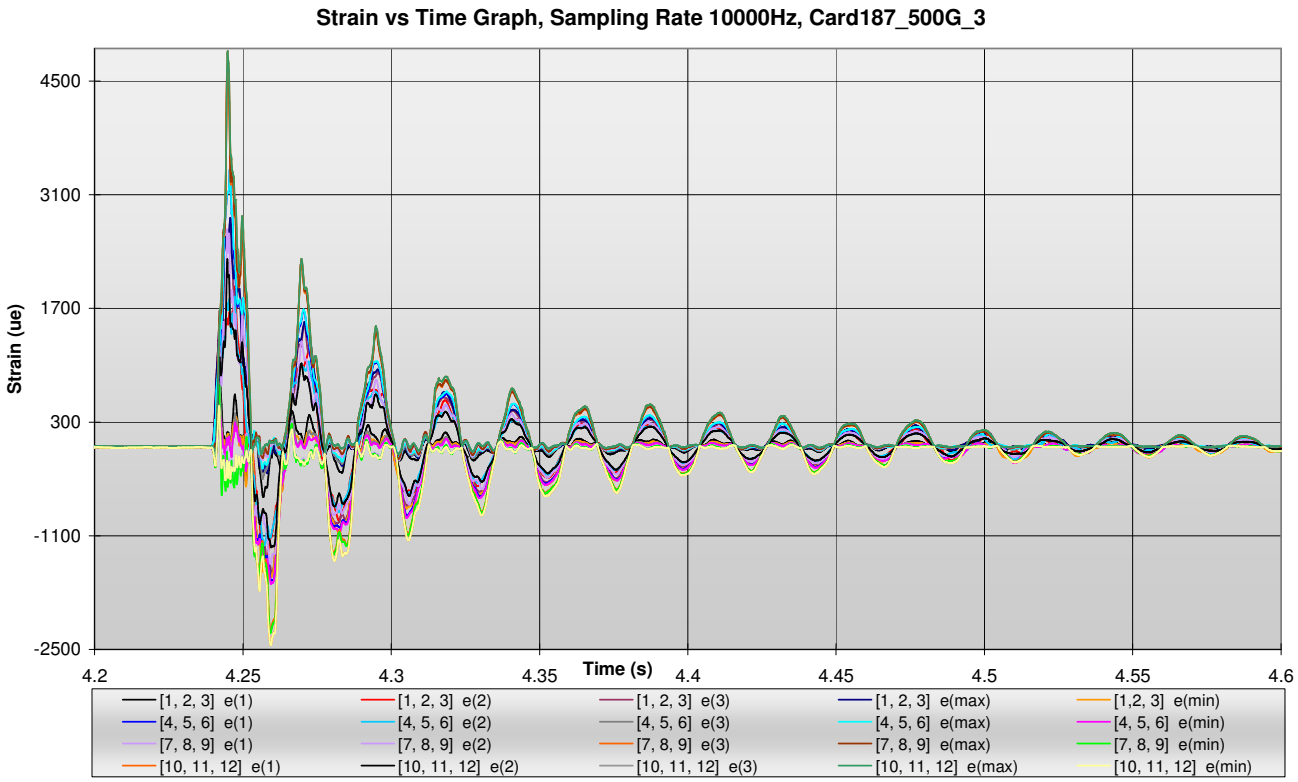
Card 187 - Drop 1



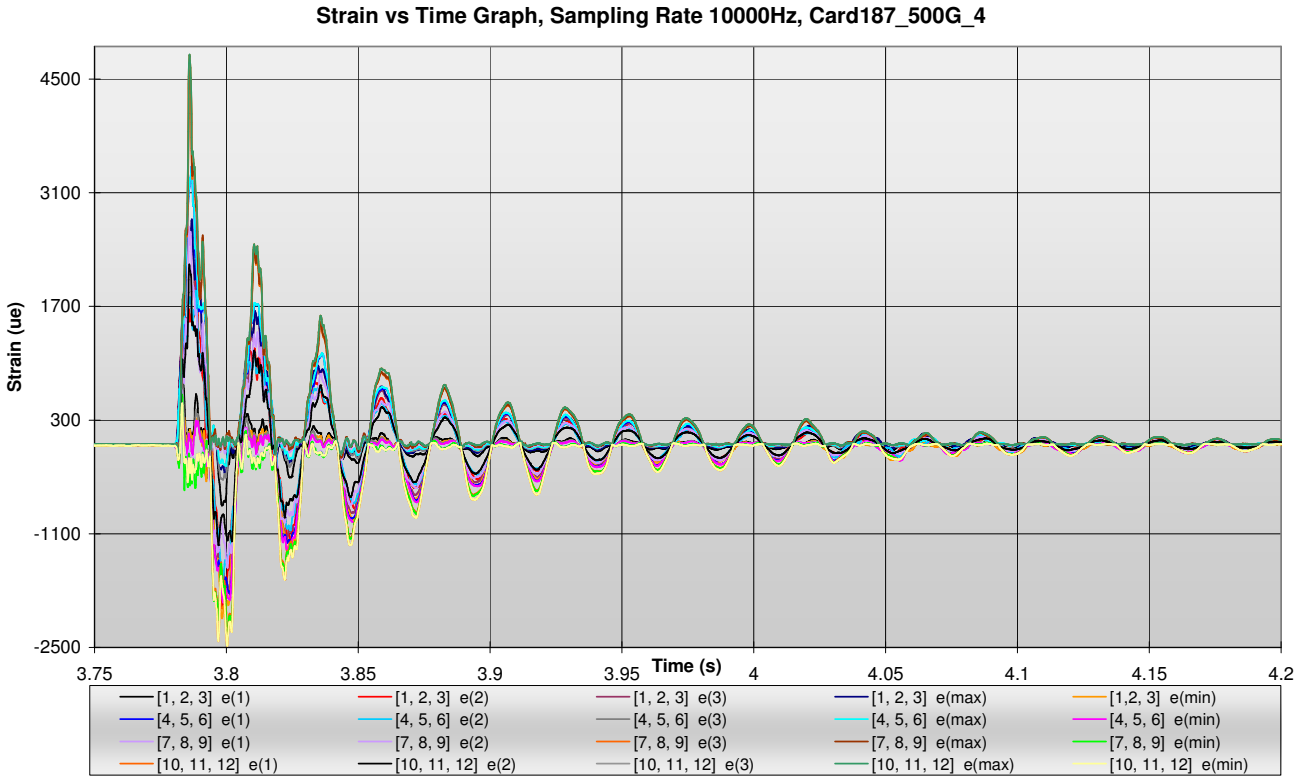
Card 187 - Drop 2



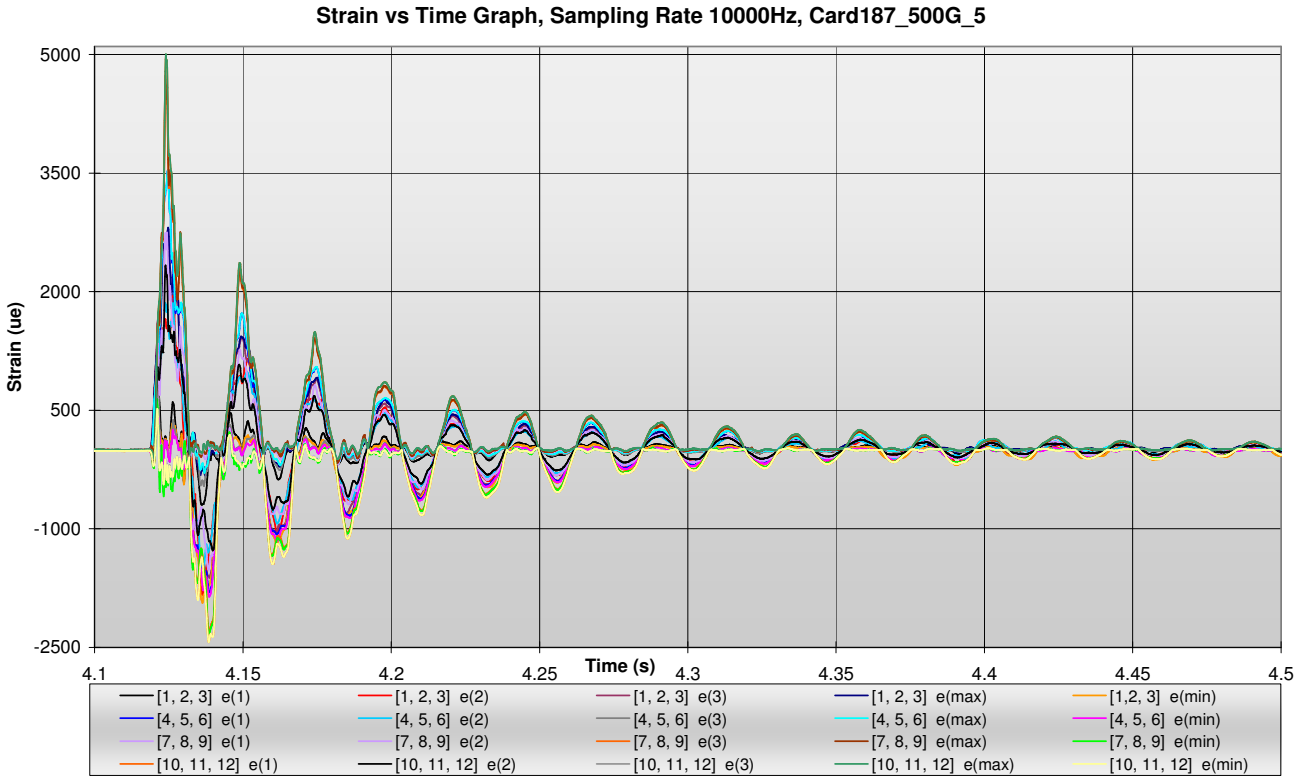
Card 187 - Drop 3



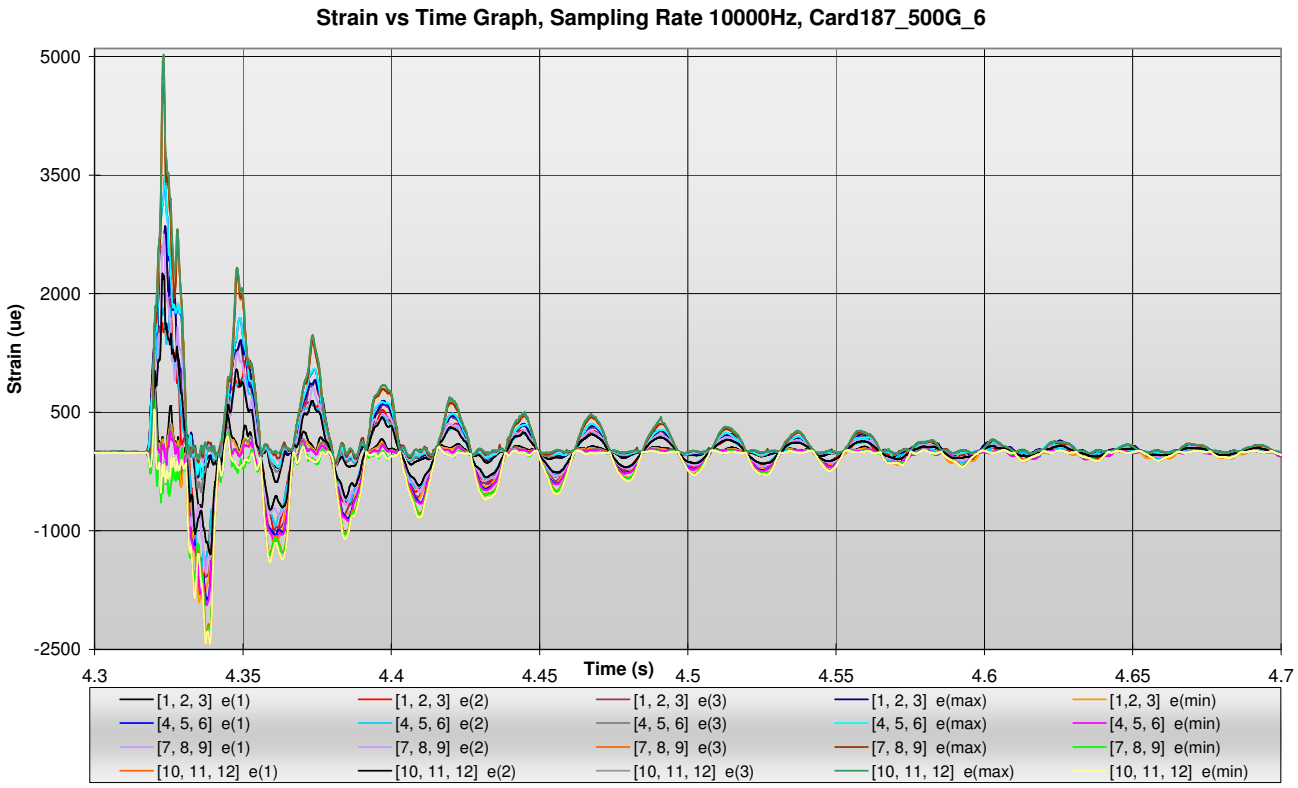
Card 187 - Drop 4



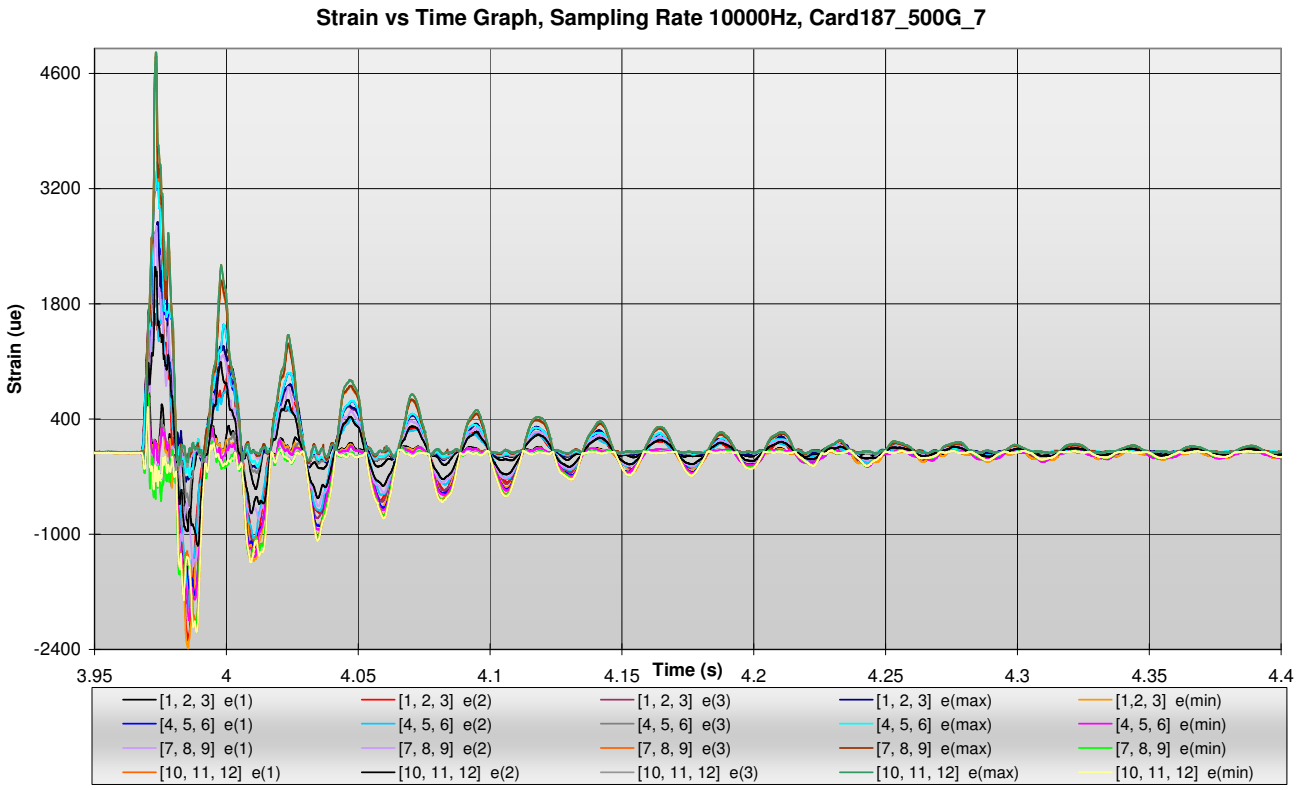
Card 187 - Drop 5



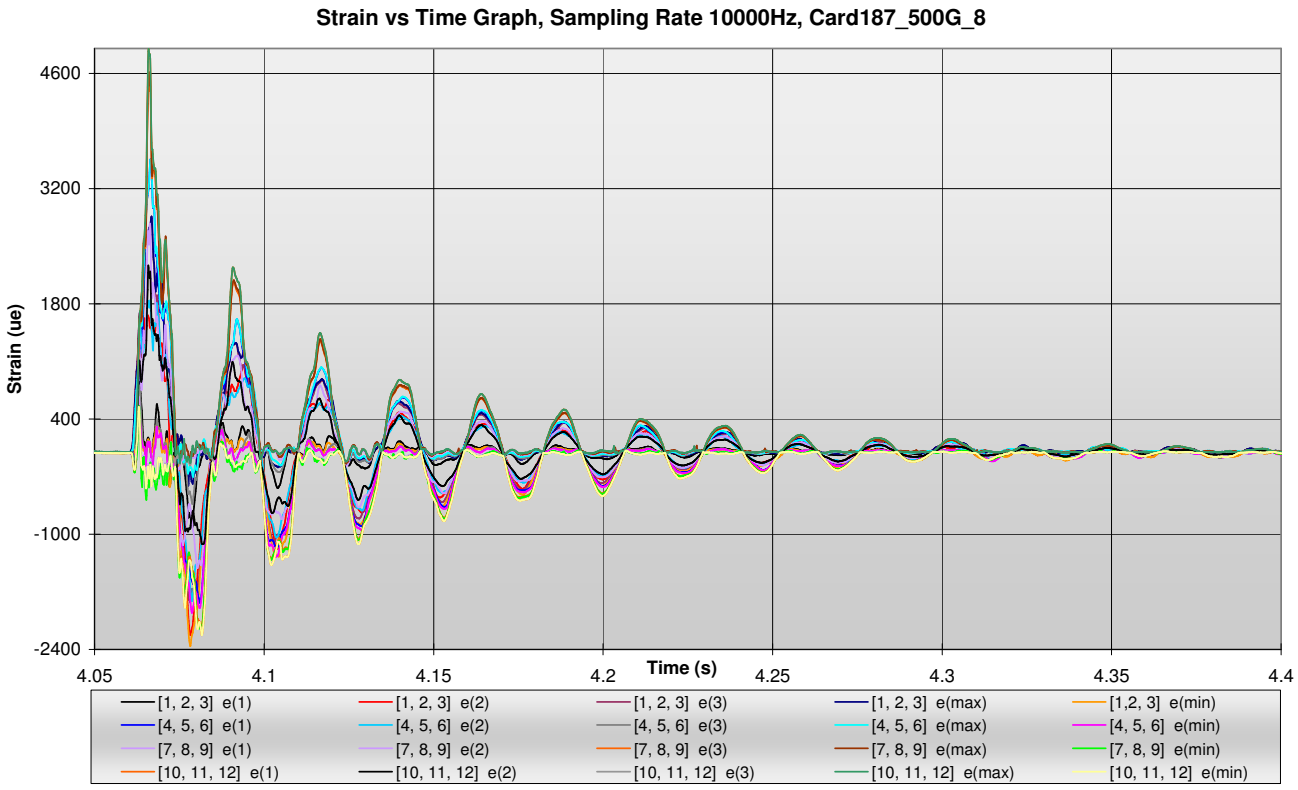
Card 187 - Drop 6



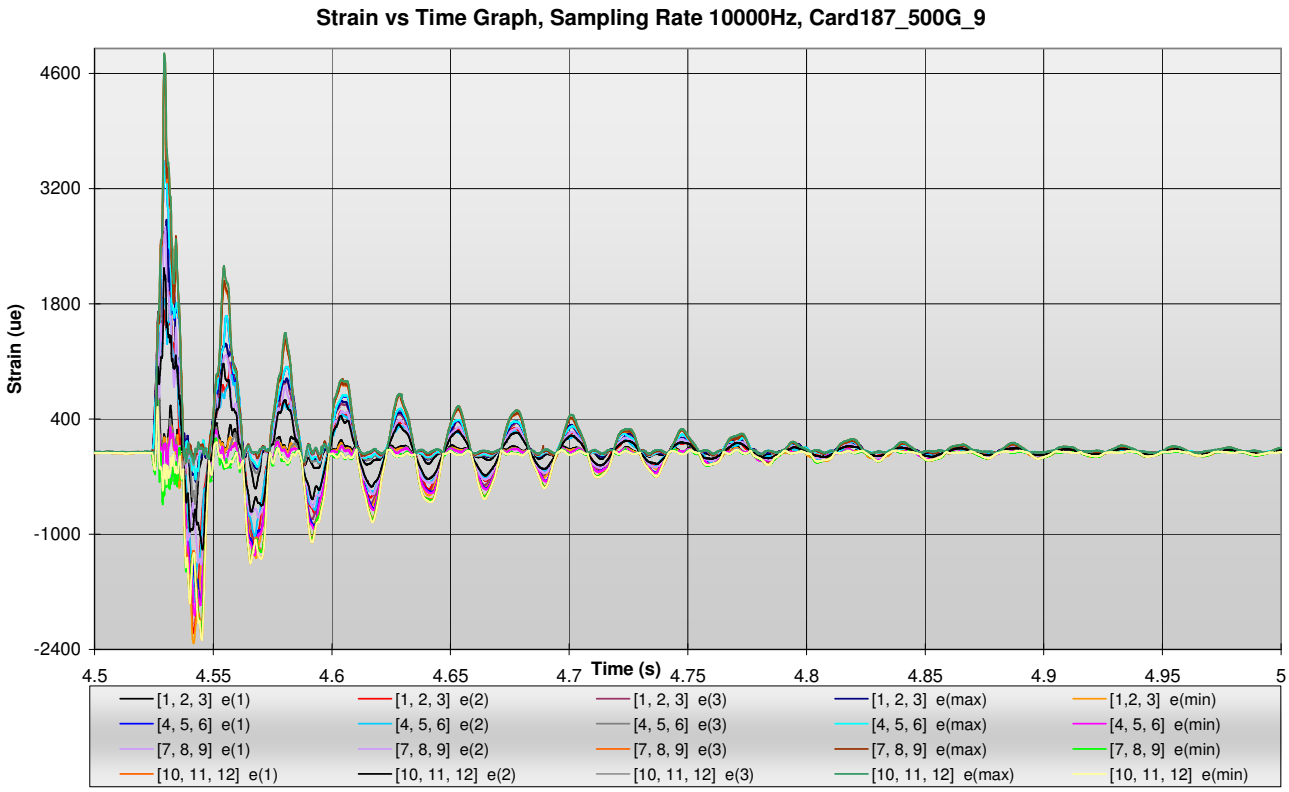
Card 187 - Drop 7



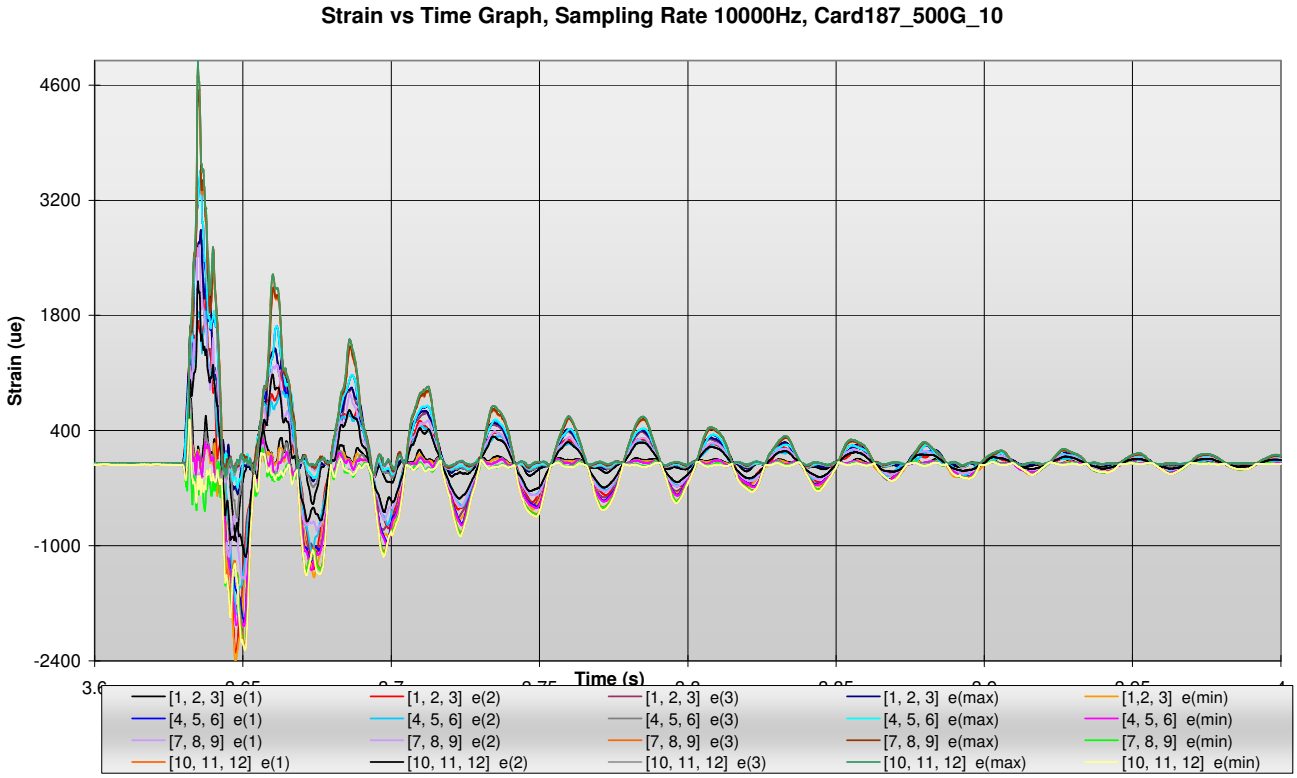
Card 187 - Drop 8



Card 187 - Drop 9

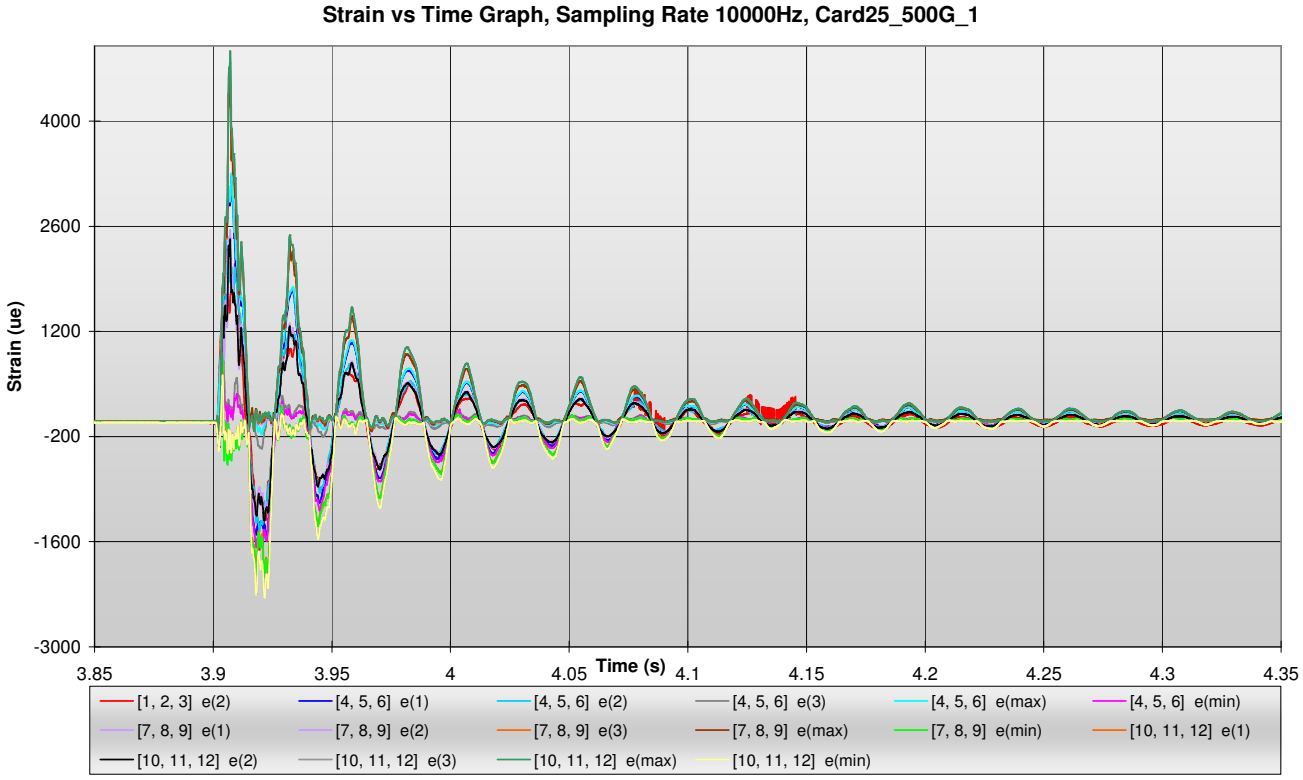


Card 187 - Drop 10

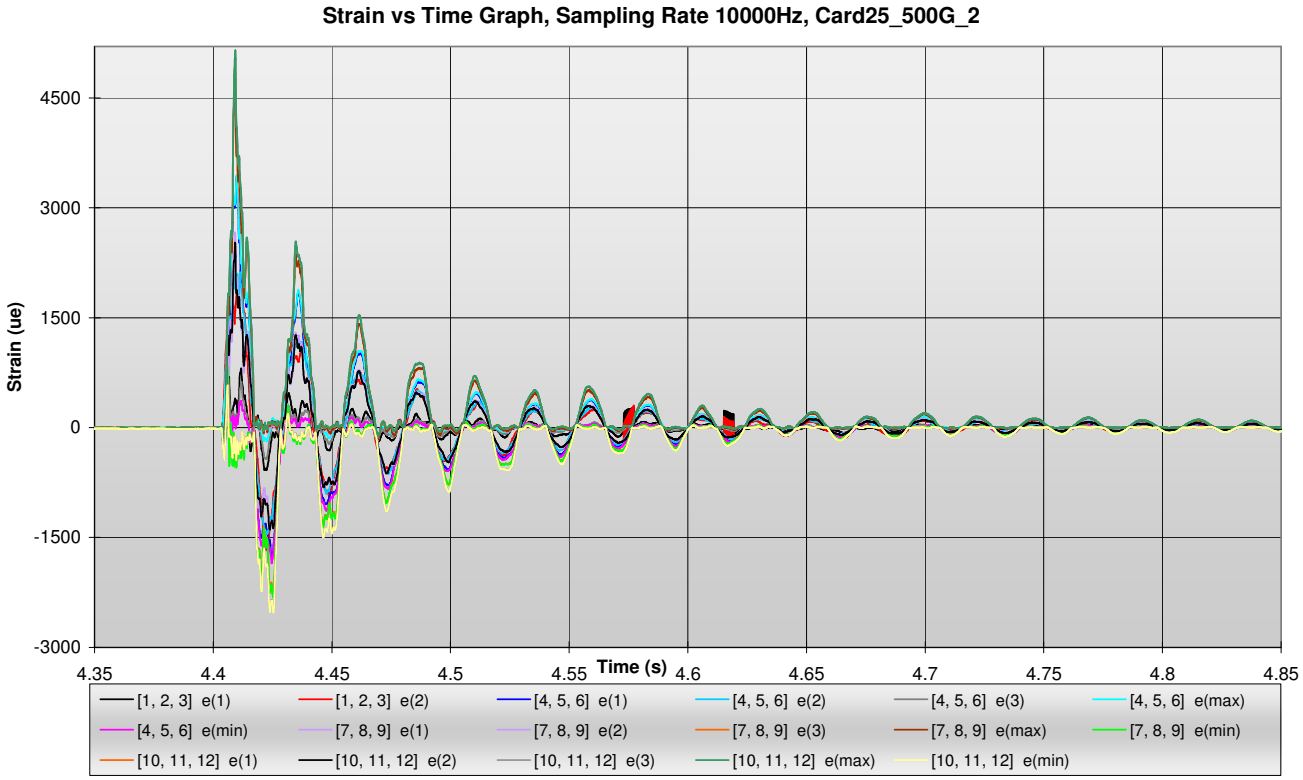


12.3 Set 5 – Card 25

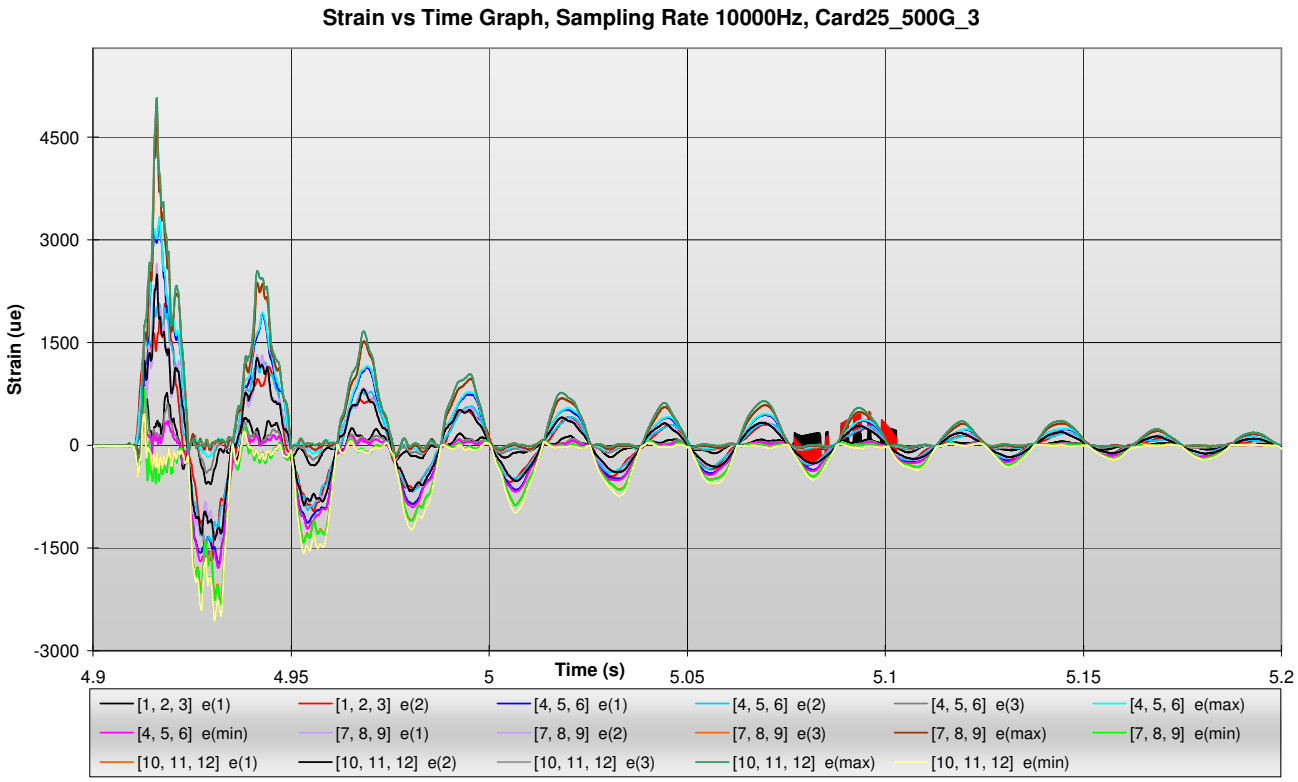
Card 25 – Drop 1



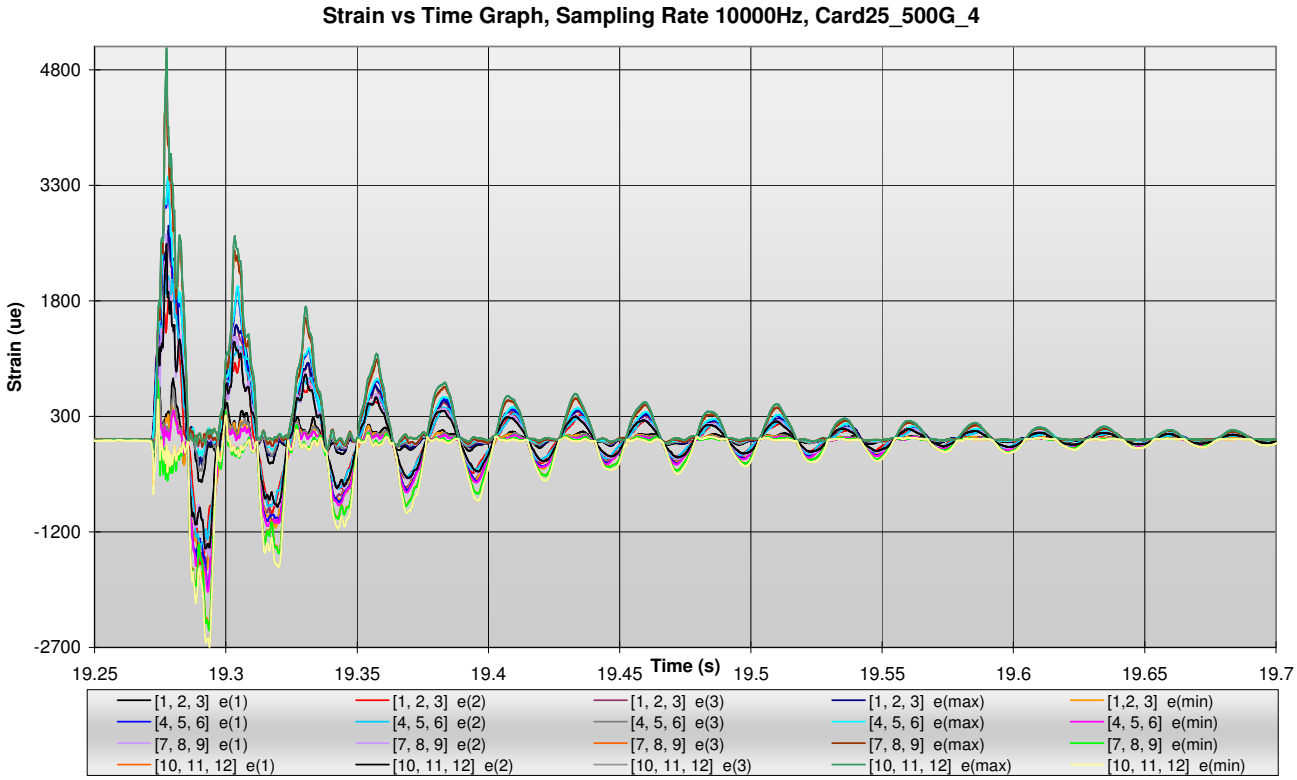
Card 25 – Drop 2



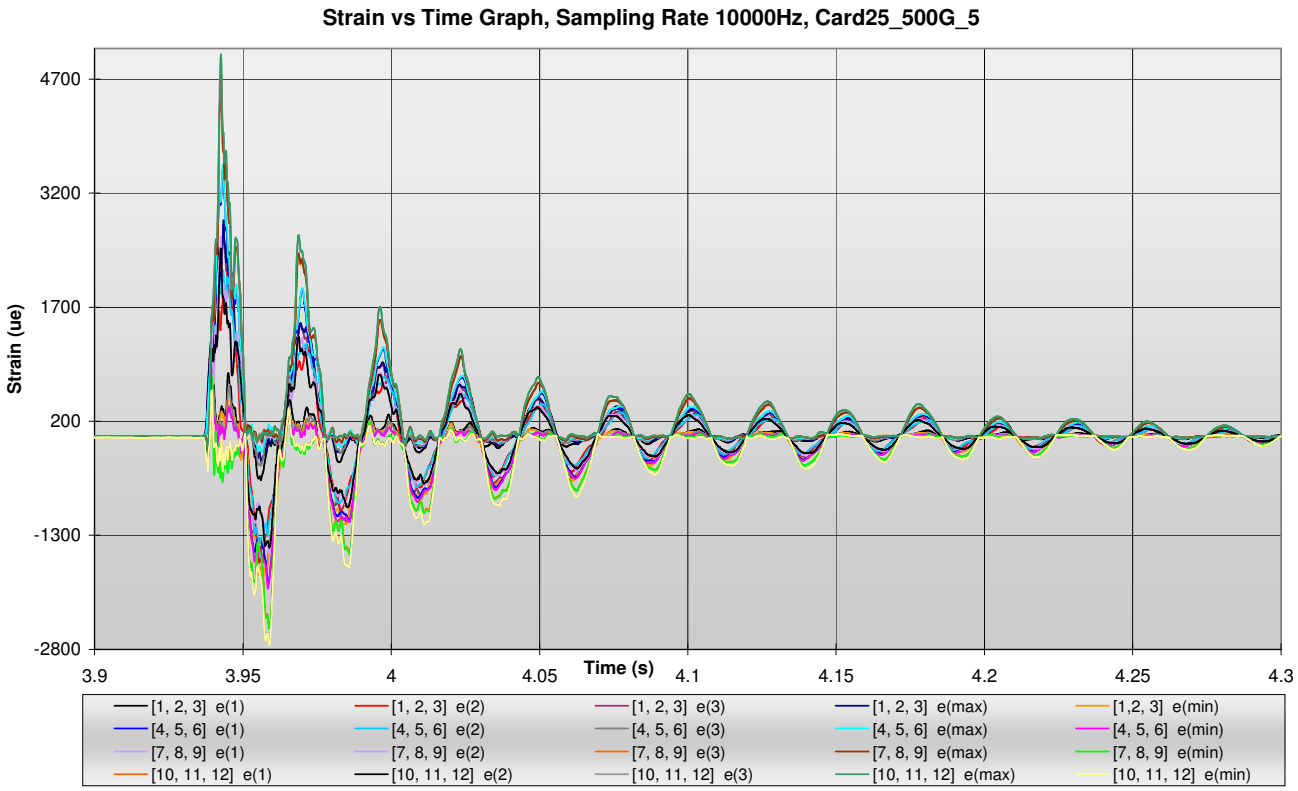
Card 25 – Drop 3



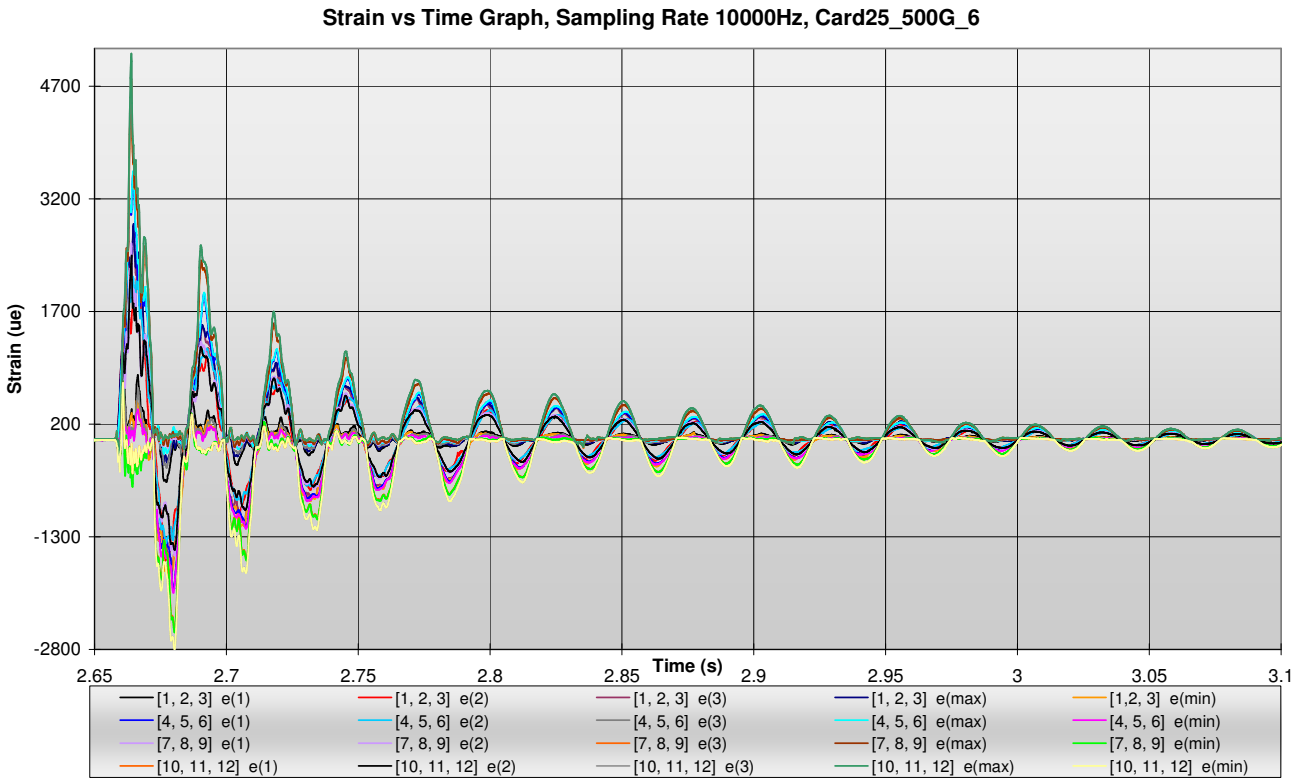
Card 25 – Drop 4



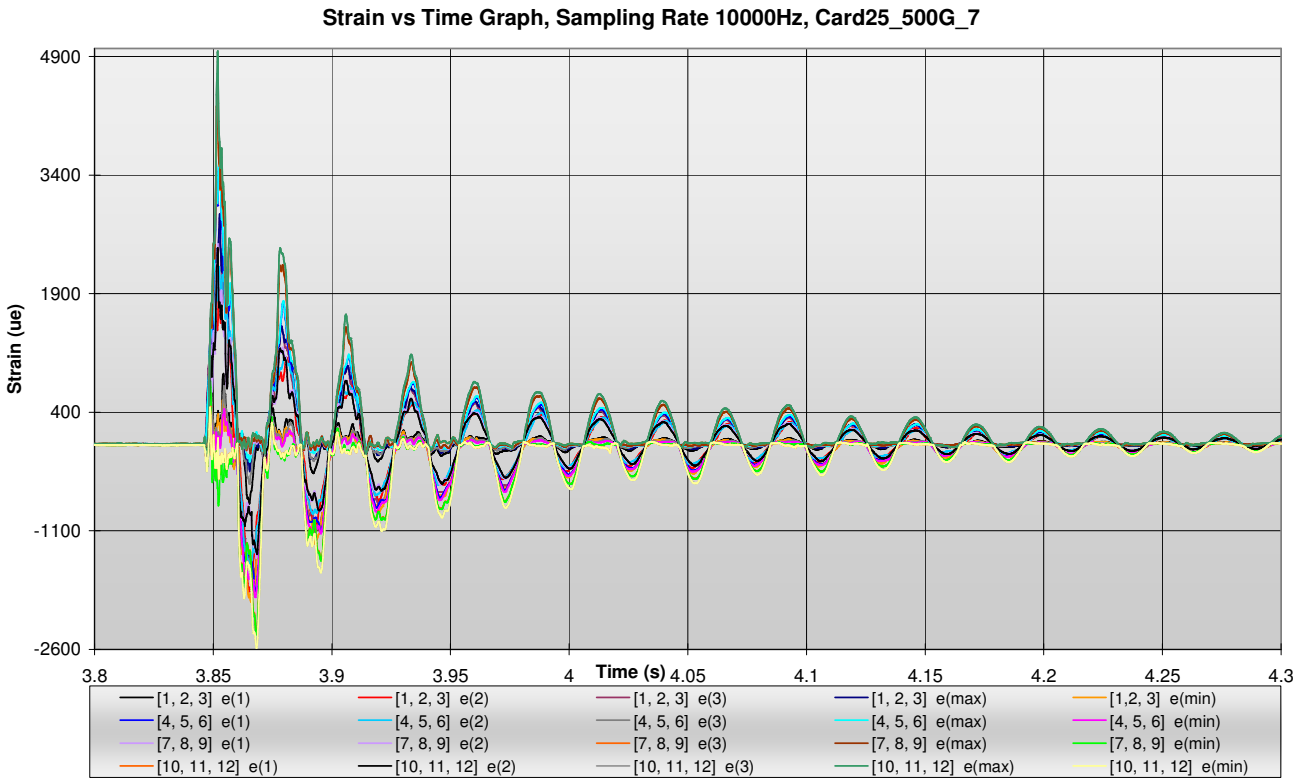
Card 25 – Drop 5



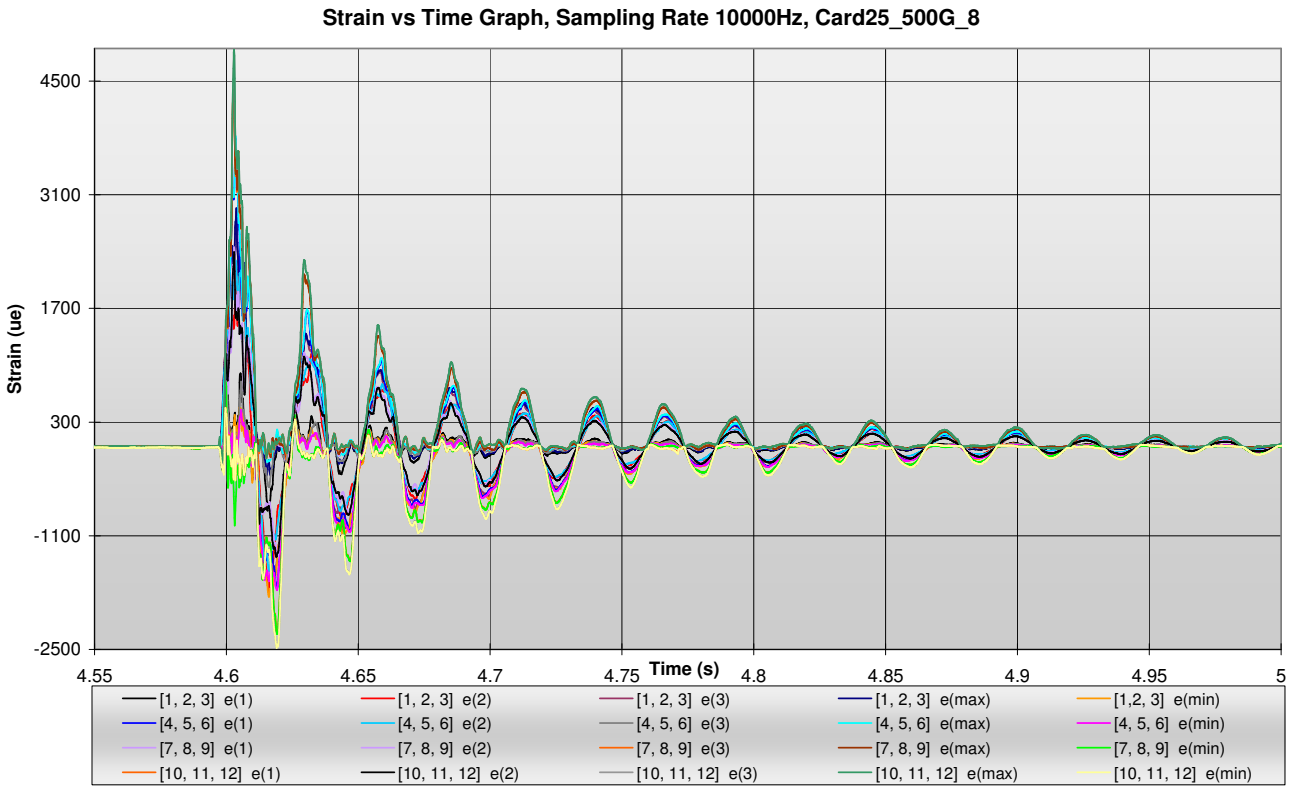
Card 25 – Drop 6



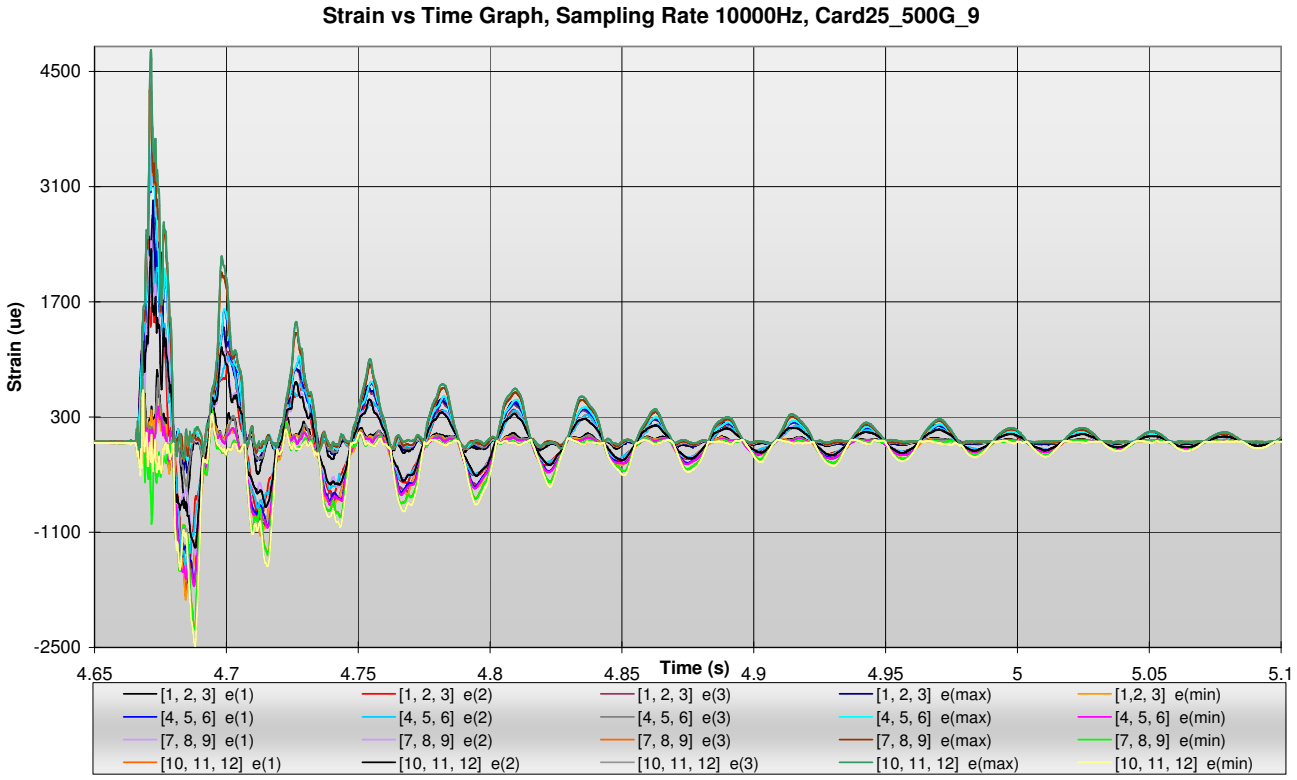
Card 25 – Drop 7



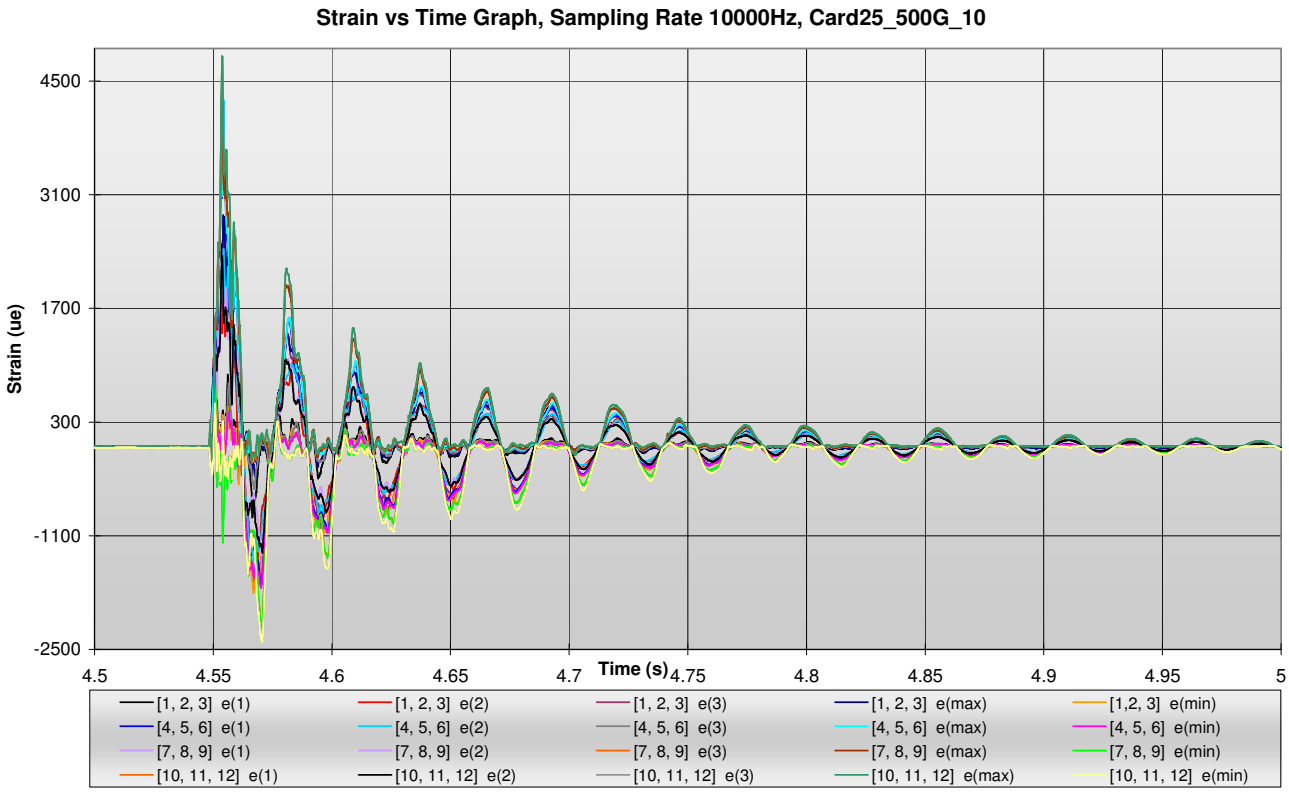
Card 25 – Drop 8



Card 25 – Drop 9

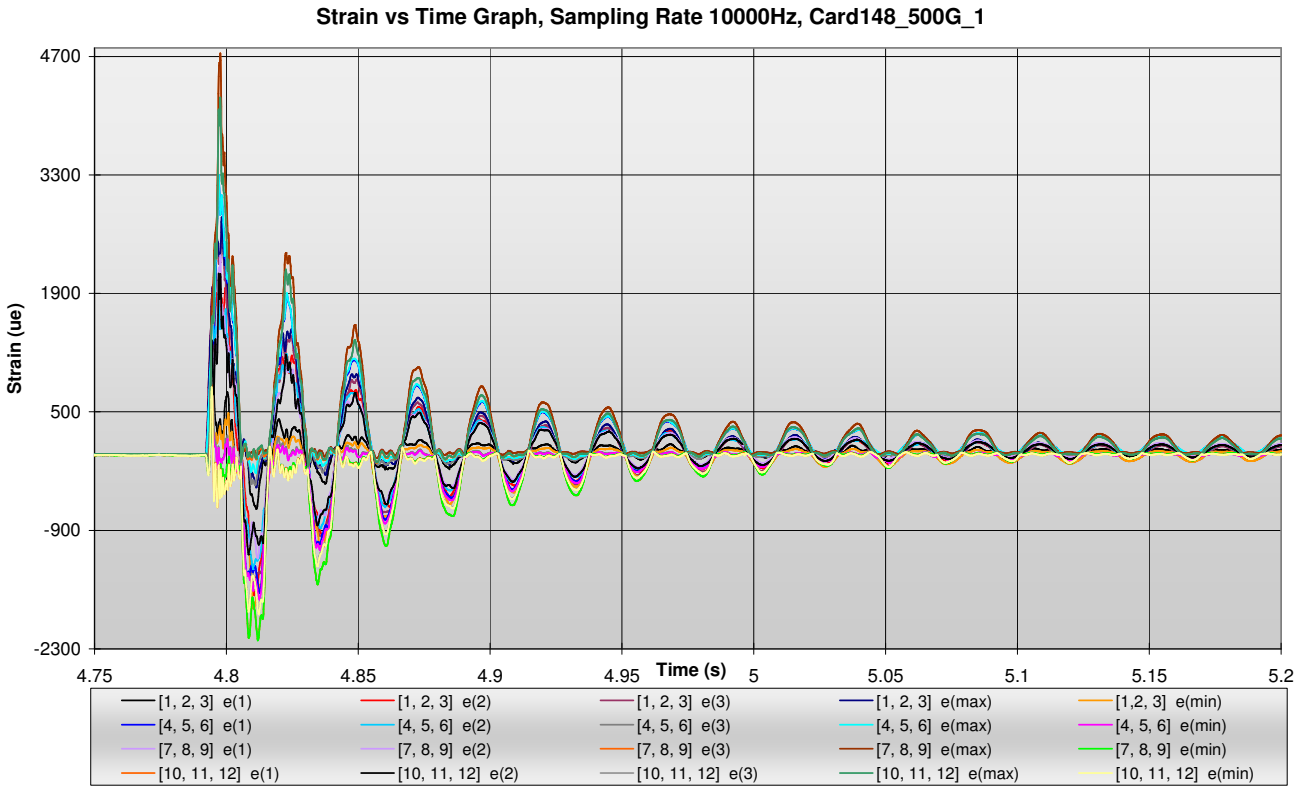


Card 25 – Drop 10

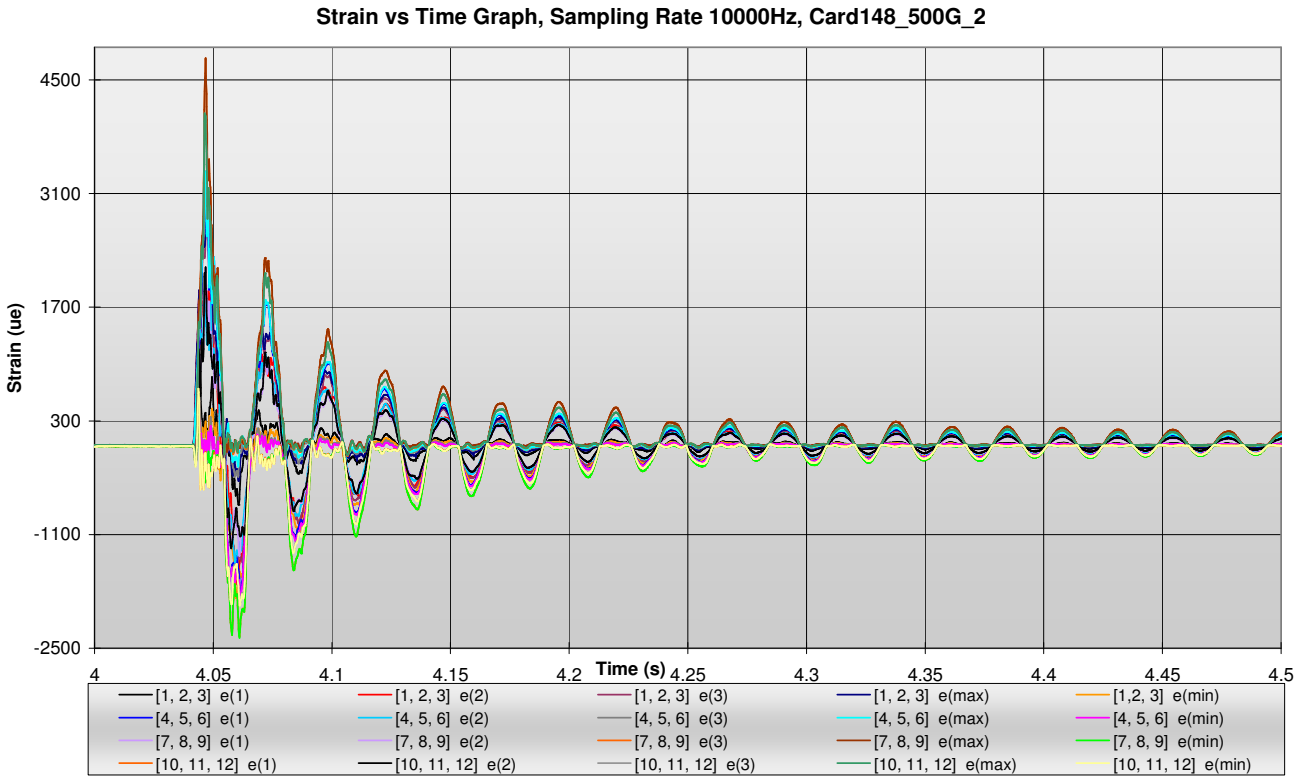


12.4 Set 6 – Card 148

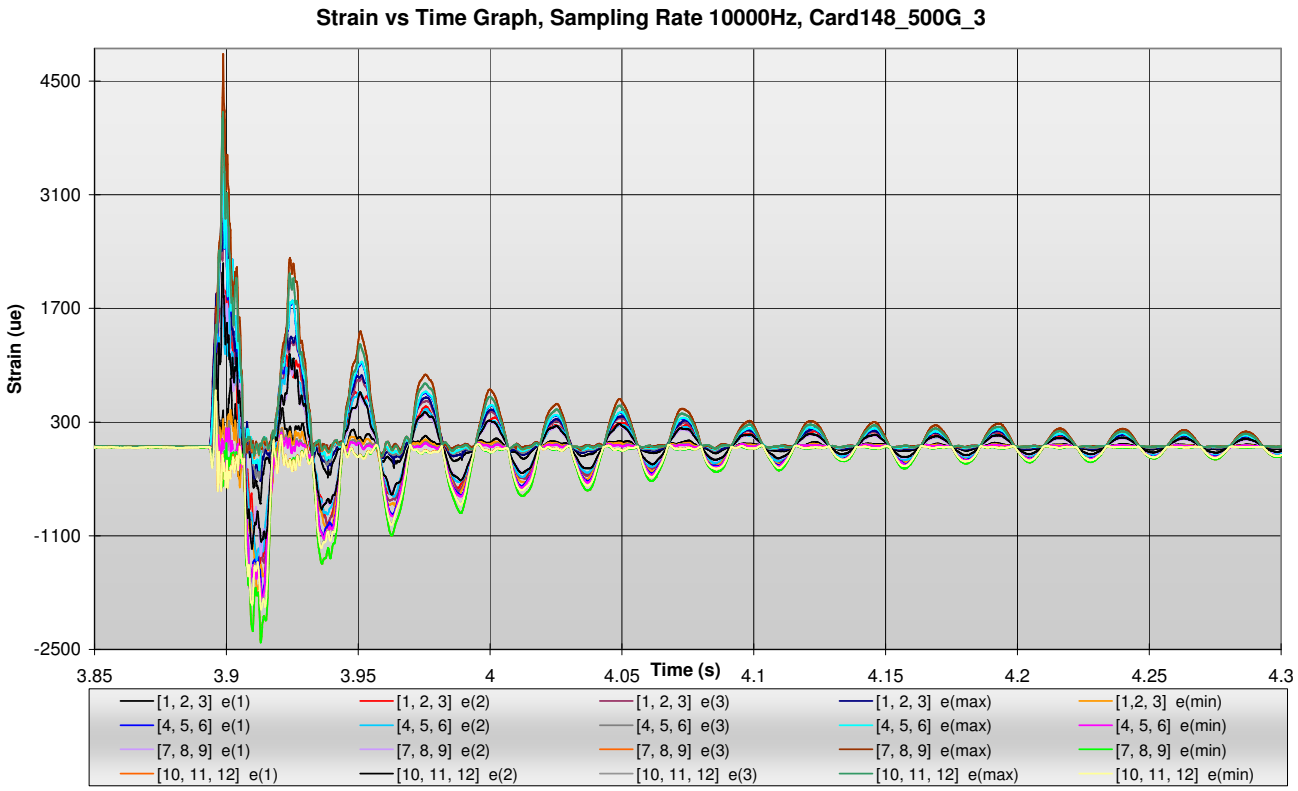
Card 148 – Drop 1



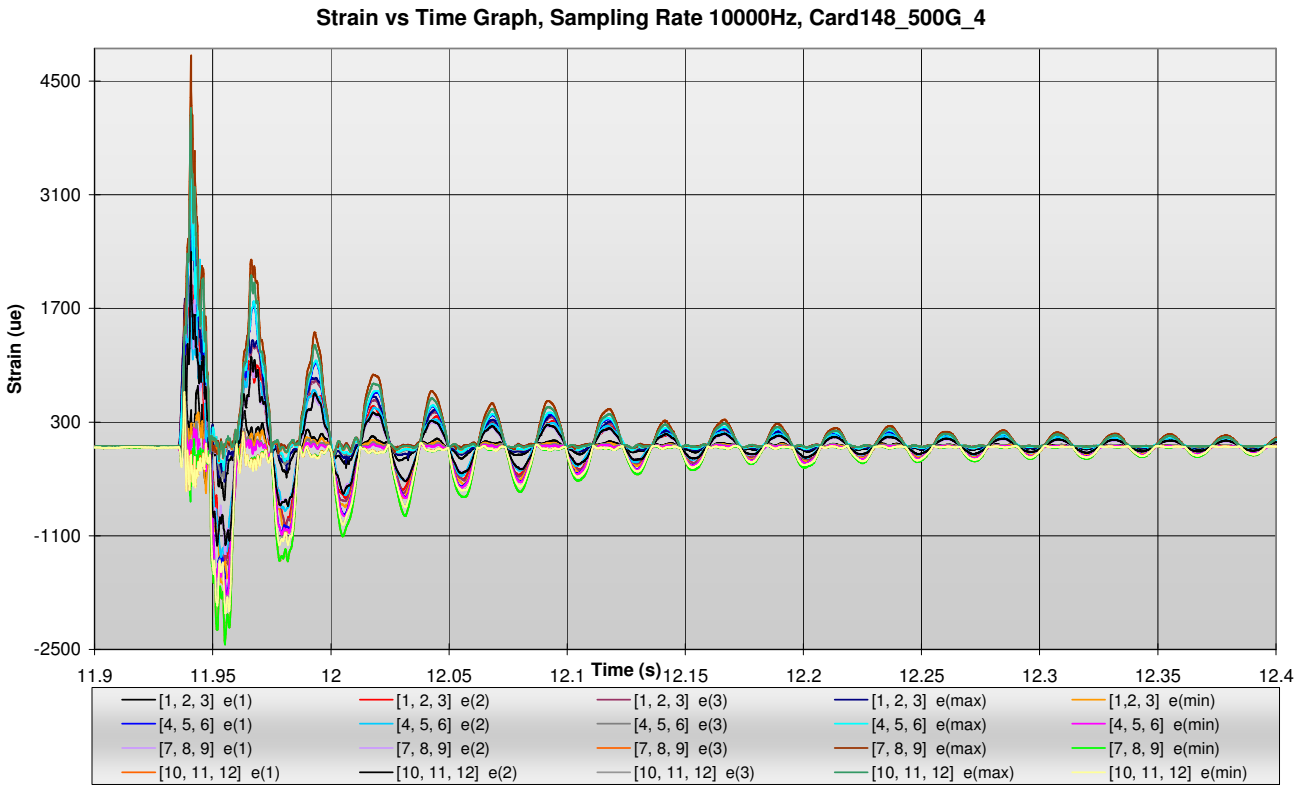
Card 148 – Drop 2



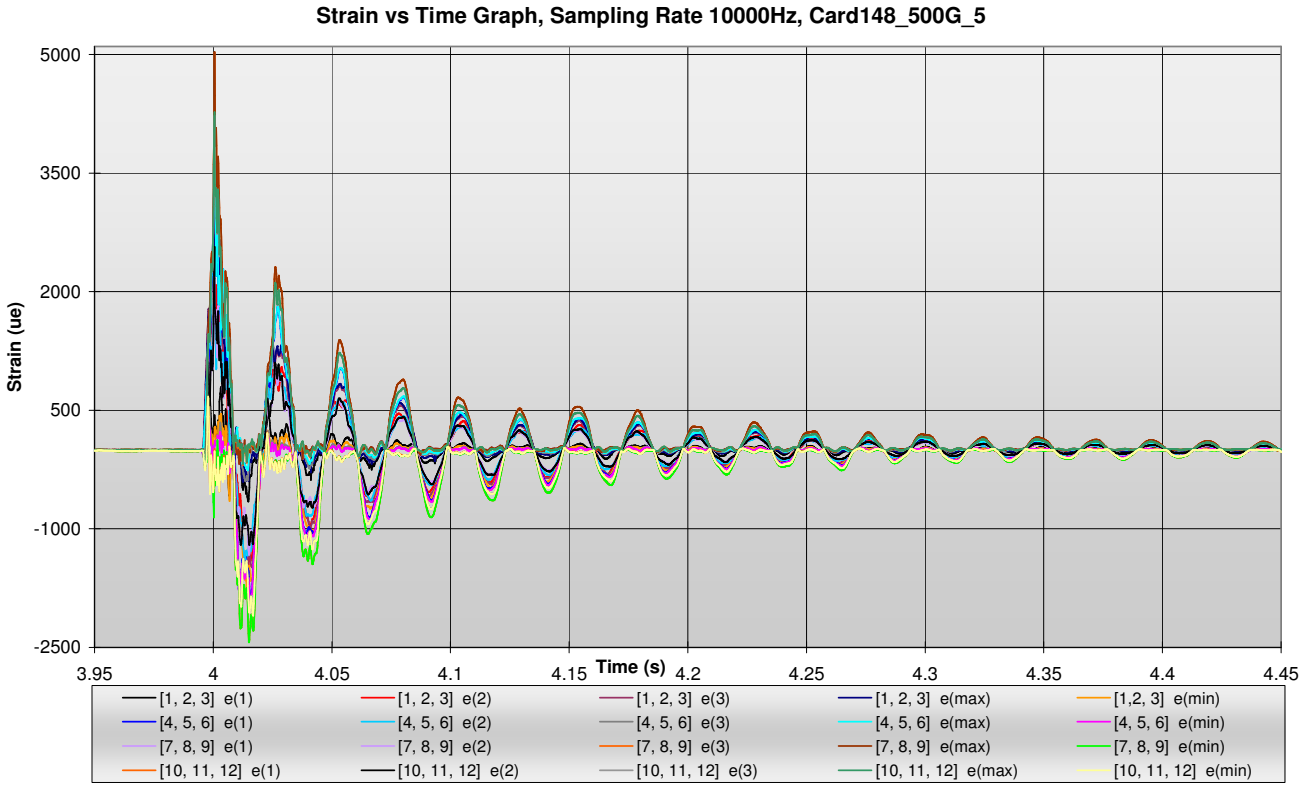
Card 148 – Drop 3



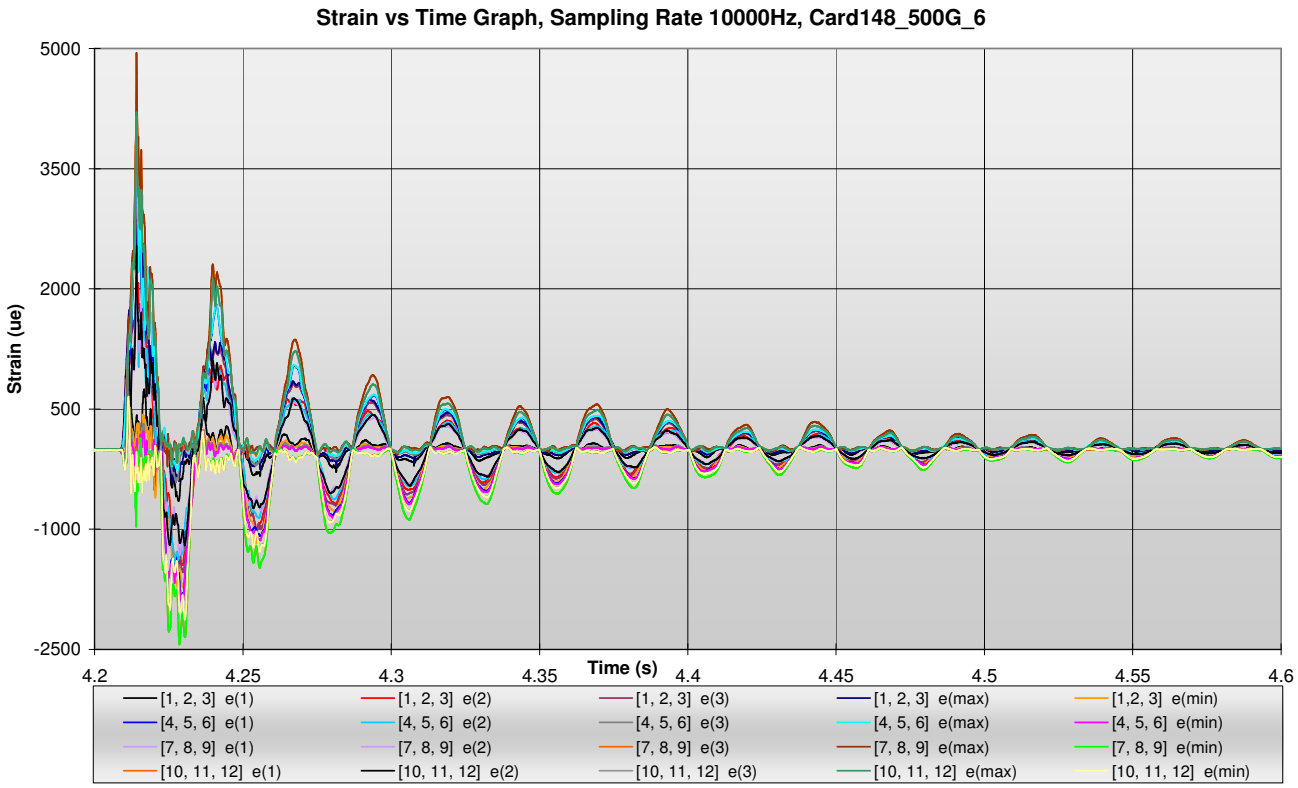
Card 148 – Drop 4



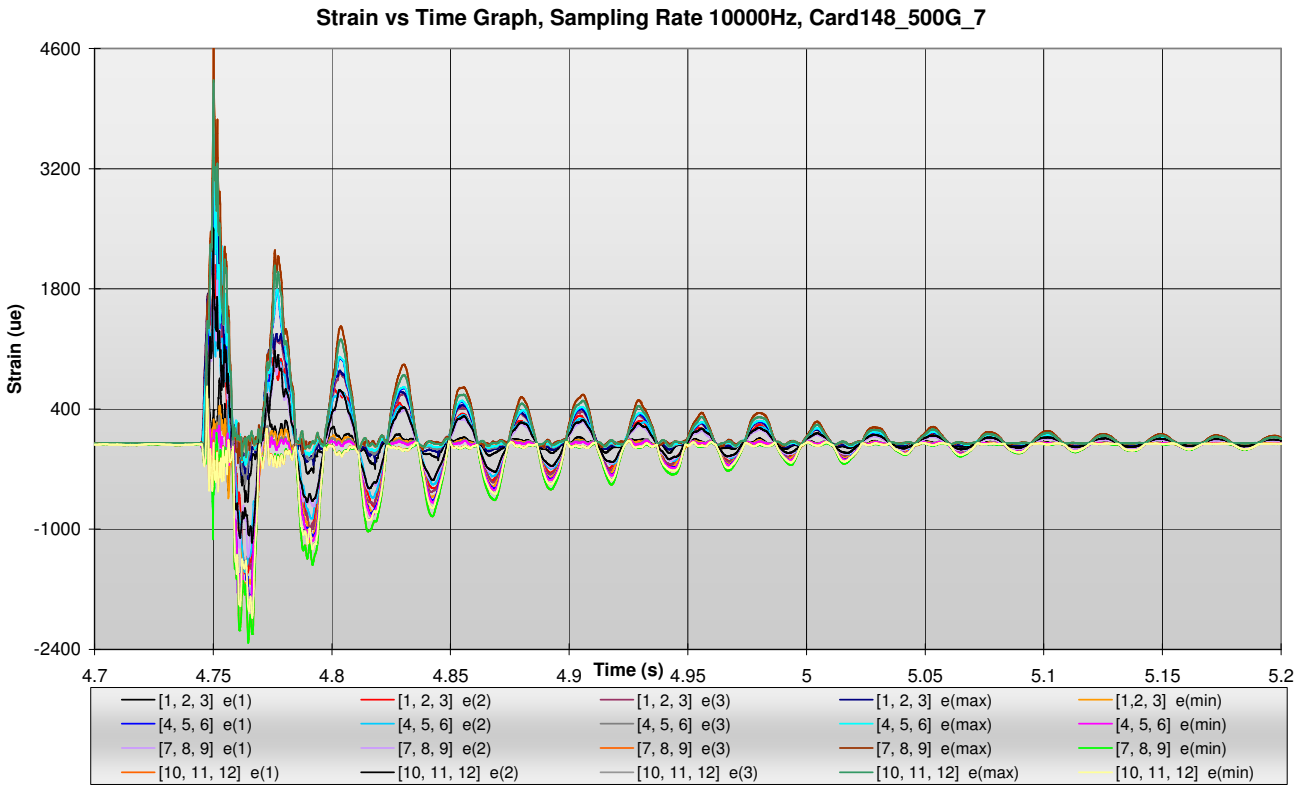
Card 148 – Drop 5



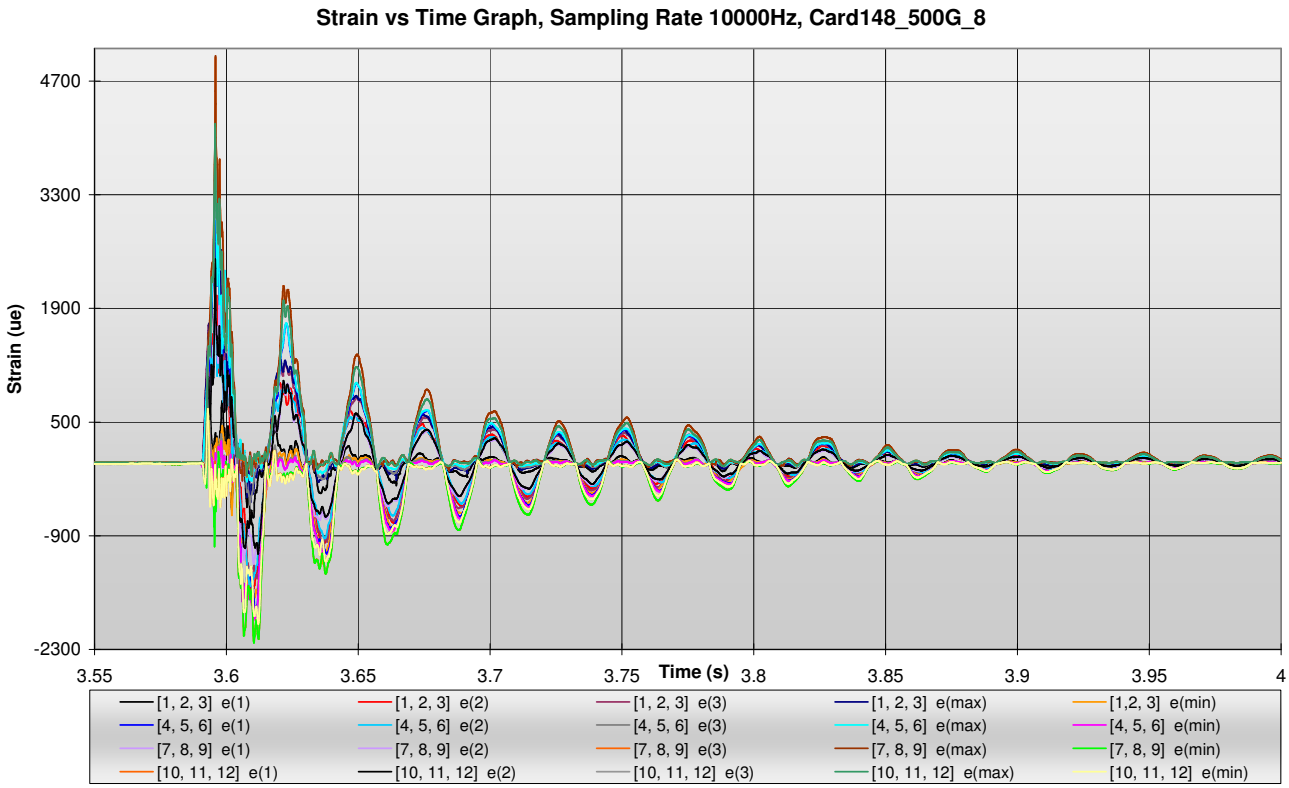
Card 148 – Drop 6



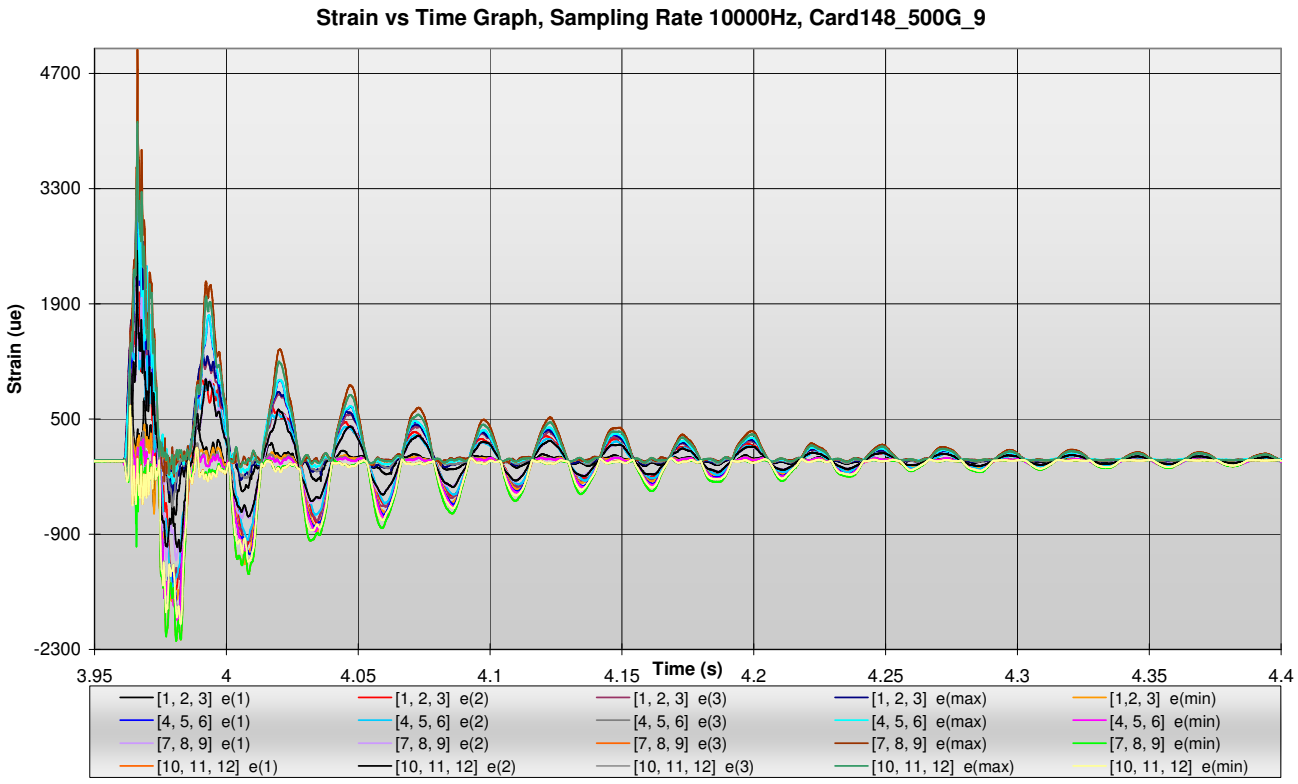
Card 148 – Drop 7



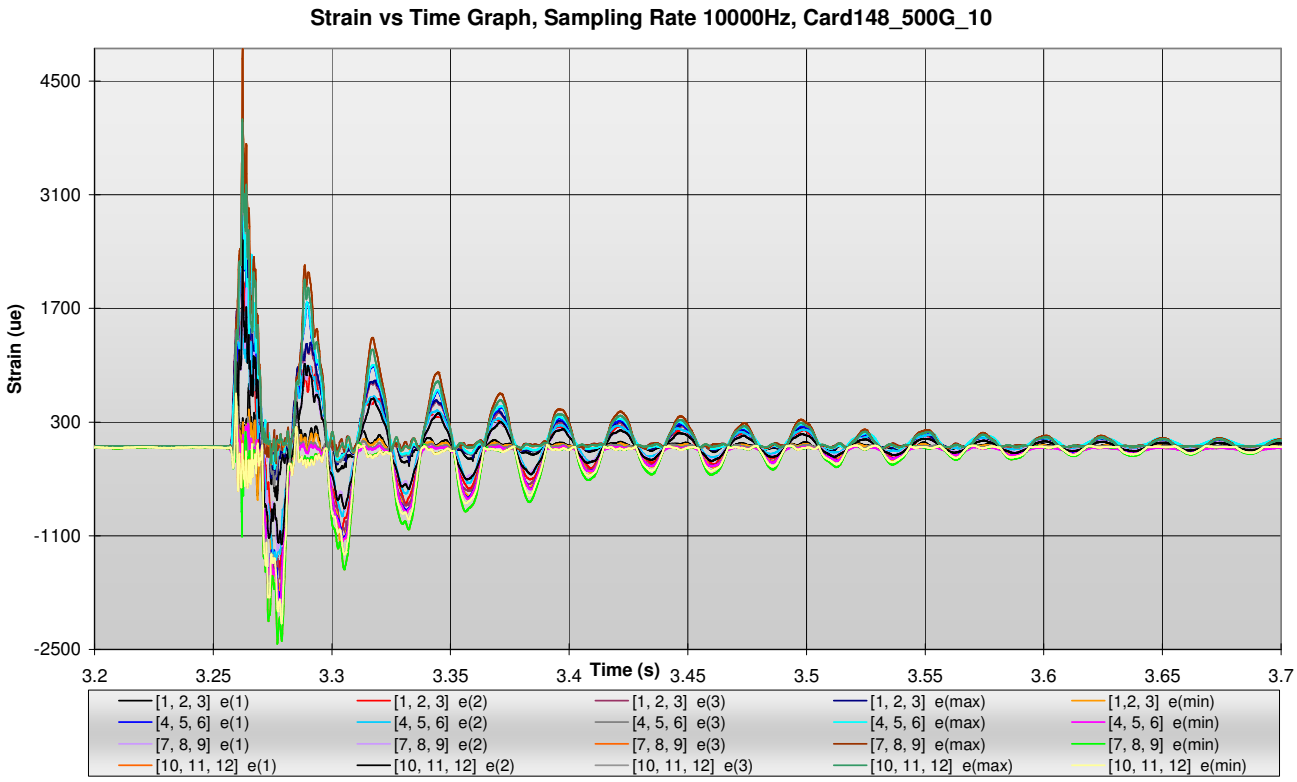
Card 148 – Drop 8



Card 148 – Drop 9

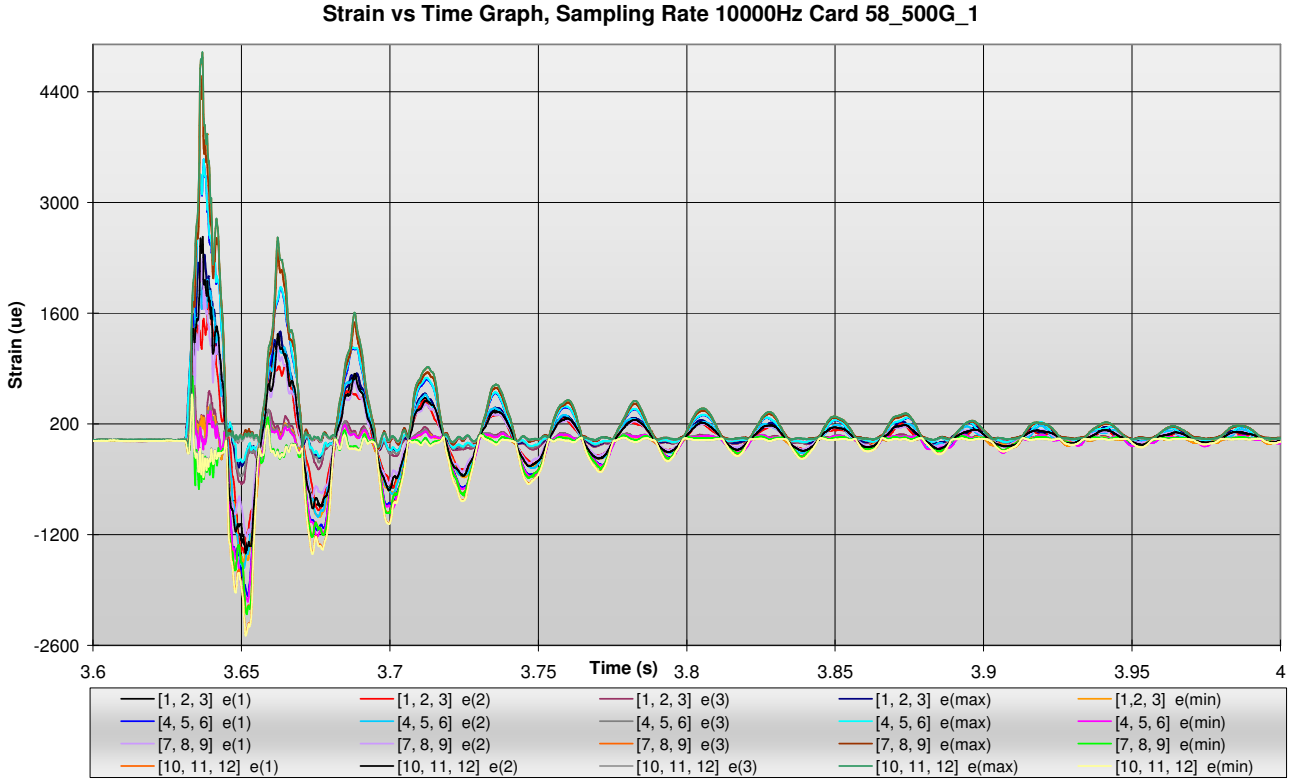


Card 148 – Drop 10

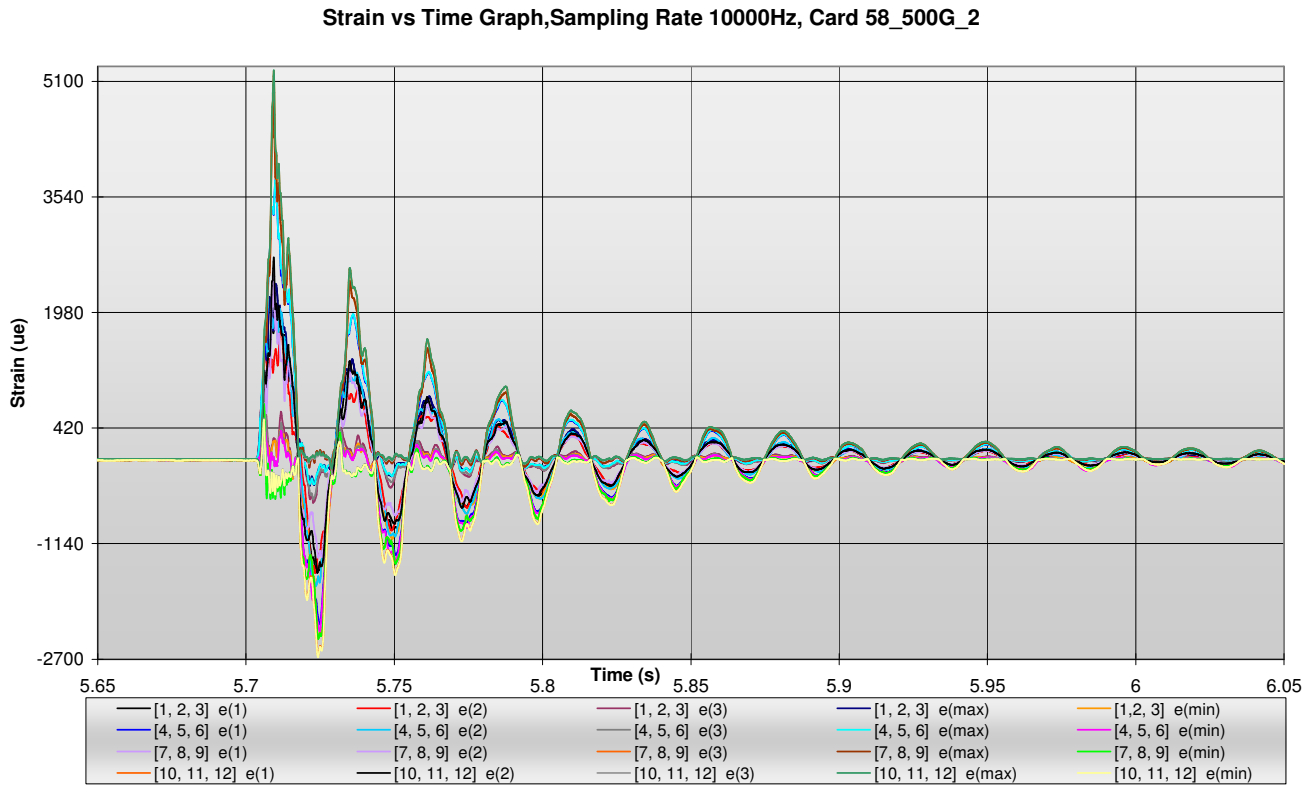


12.5 Set 7 – Card 58

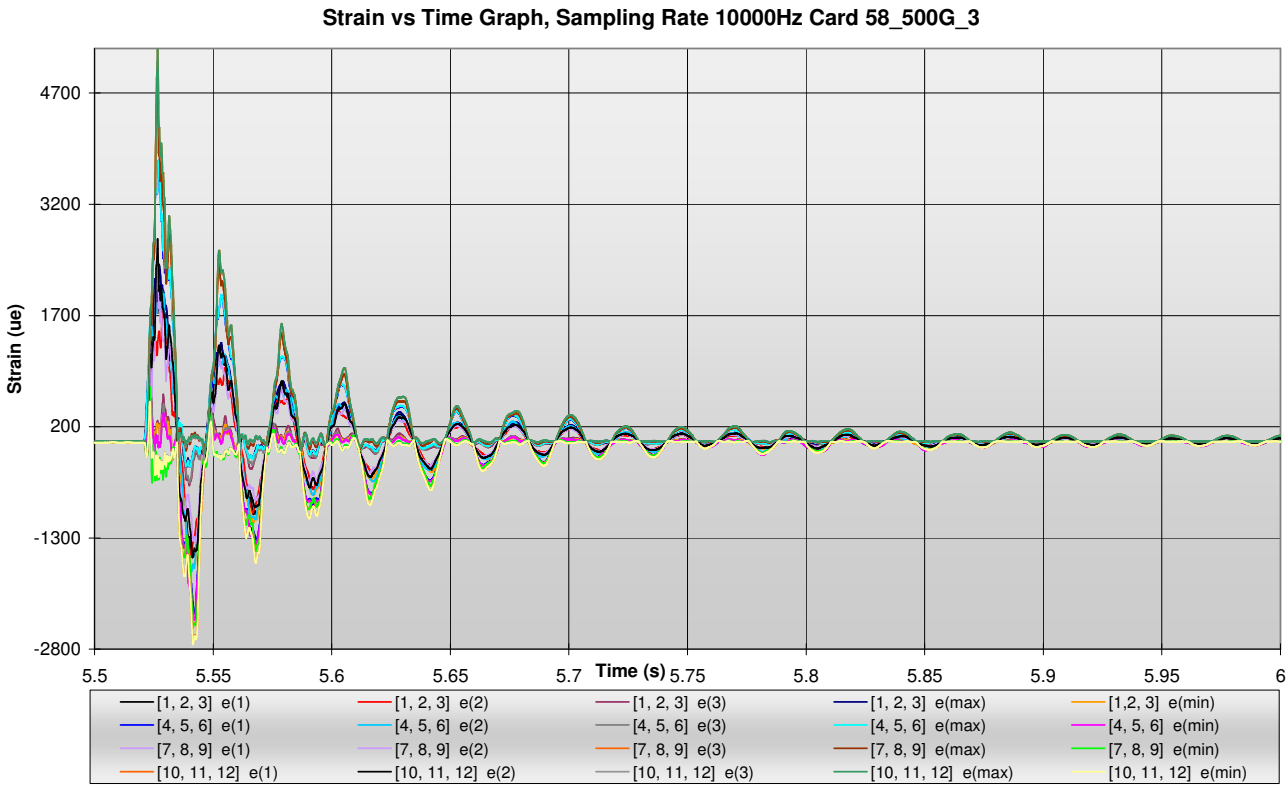
Card 58 – Drop 1



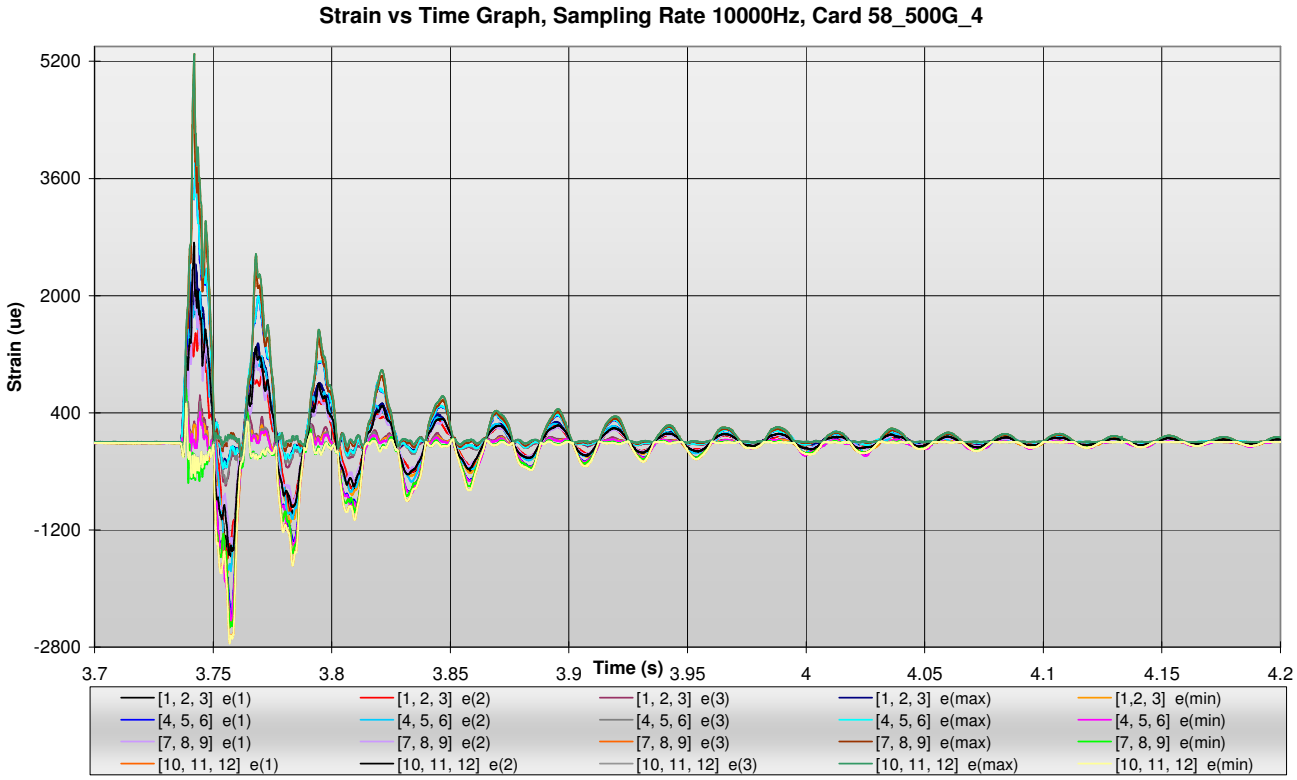
Card 58 – Drop 2



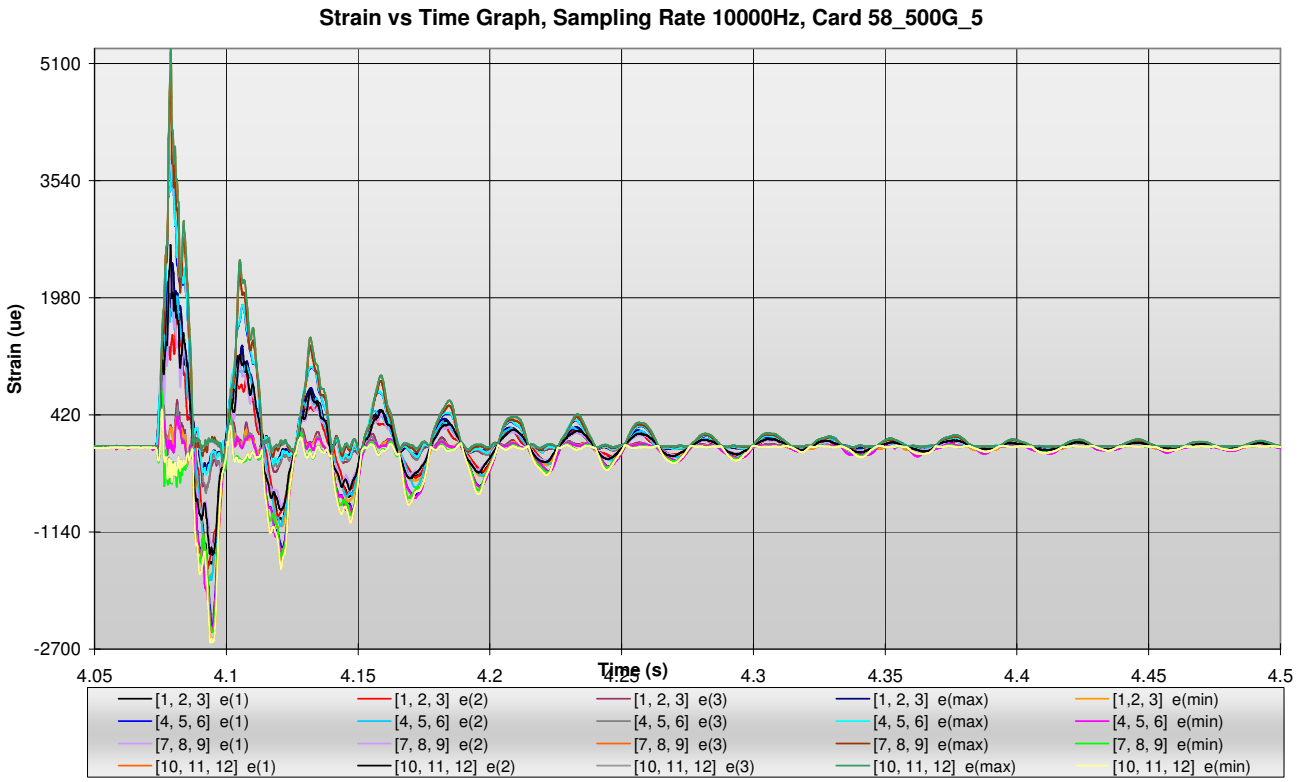
Card 58 – Drop 3



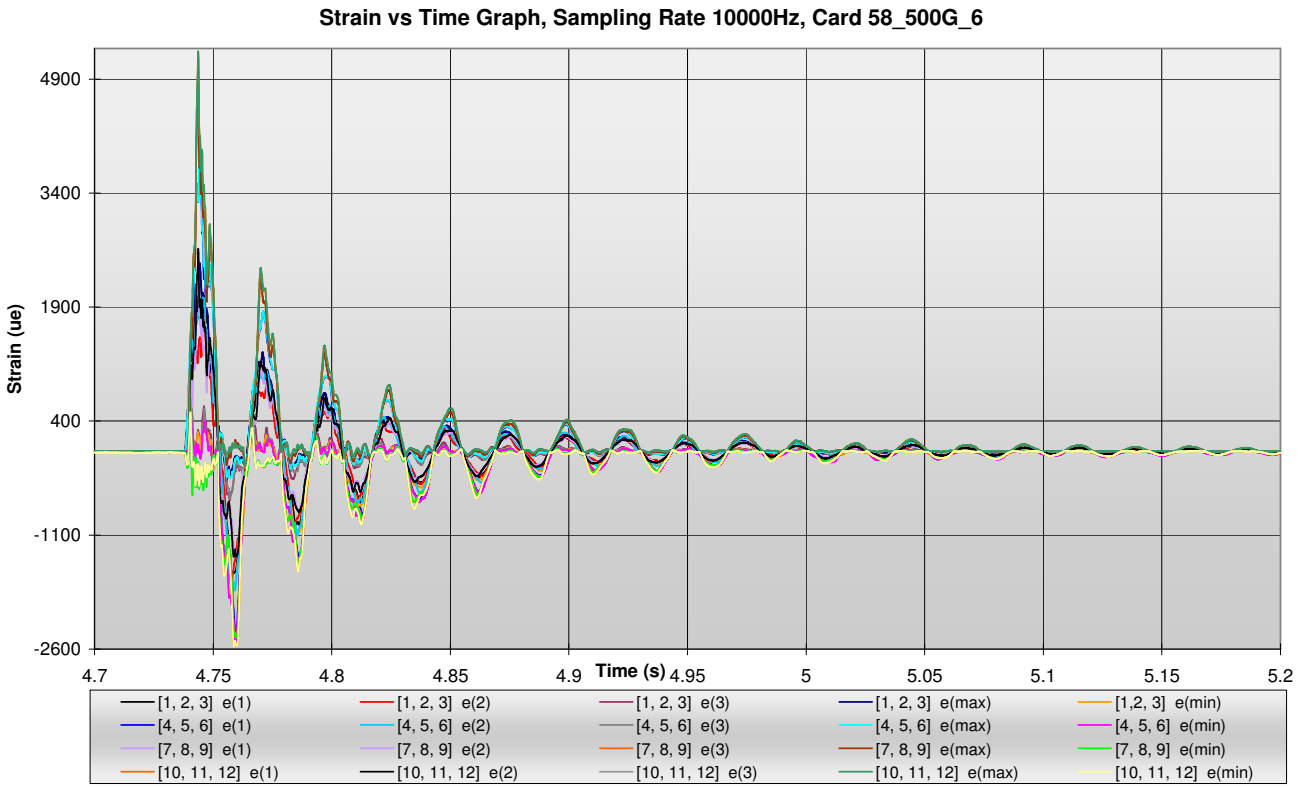
Card 58 – Drop 4



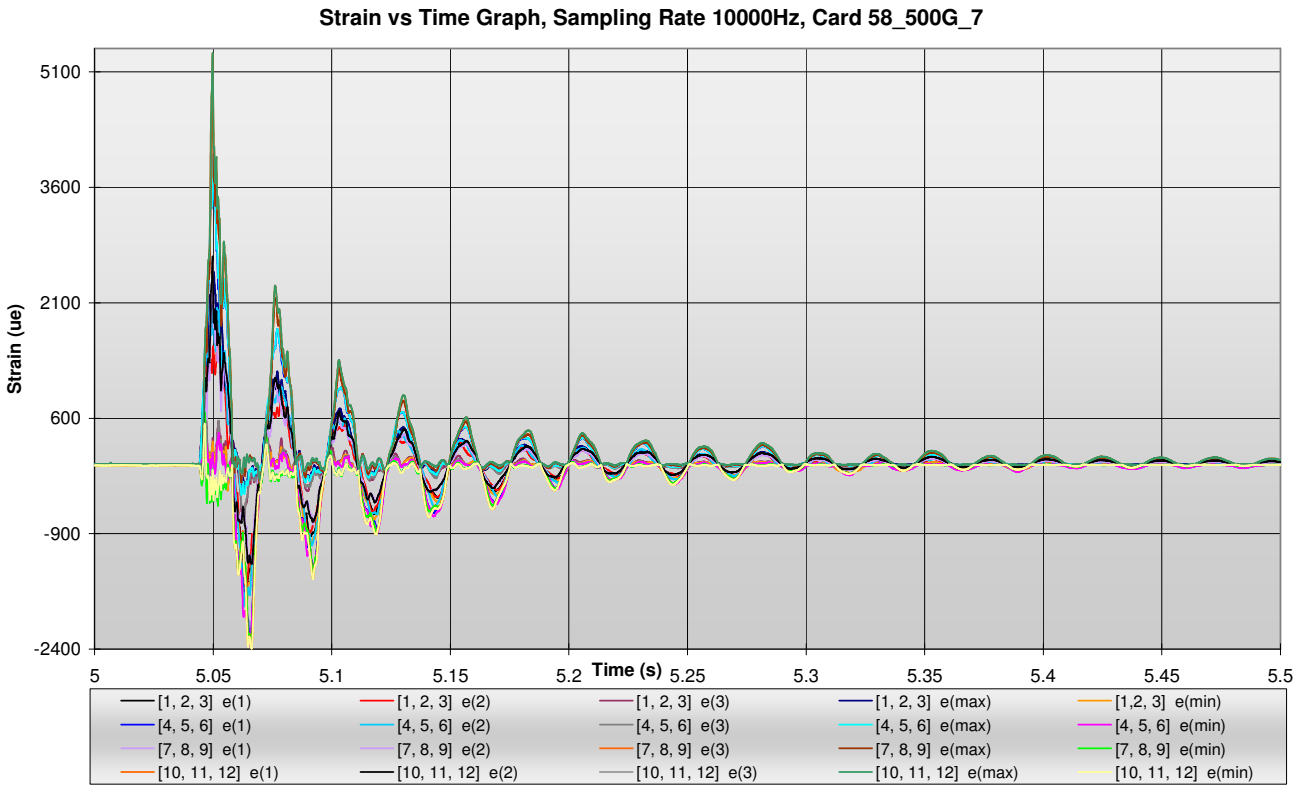
Card 58 – Drop 5



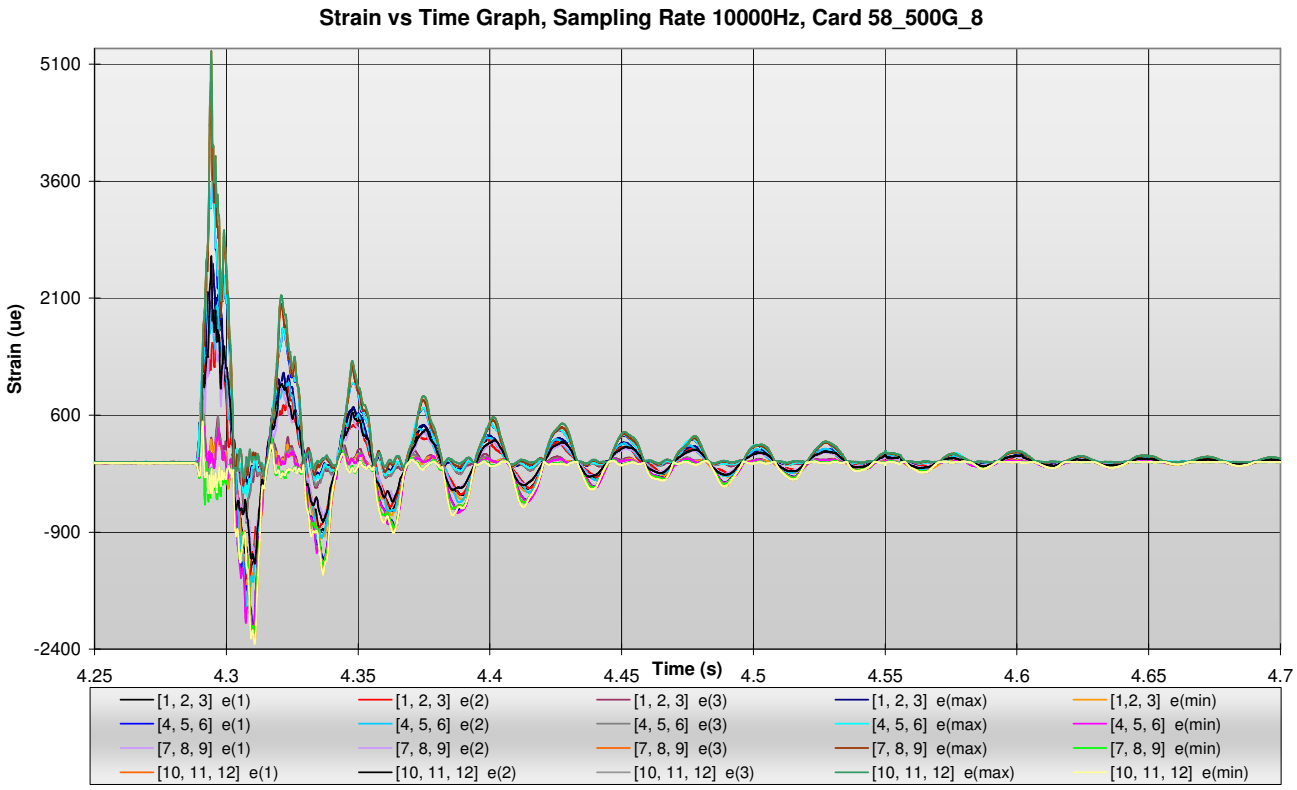
Card 58 – Drop 6



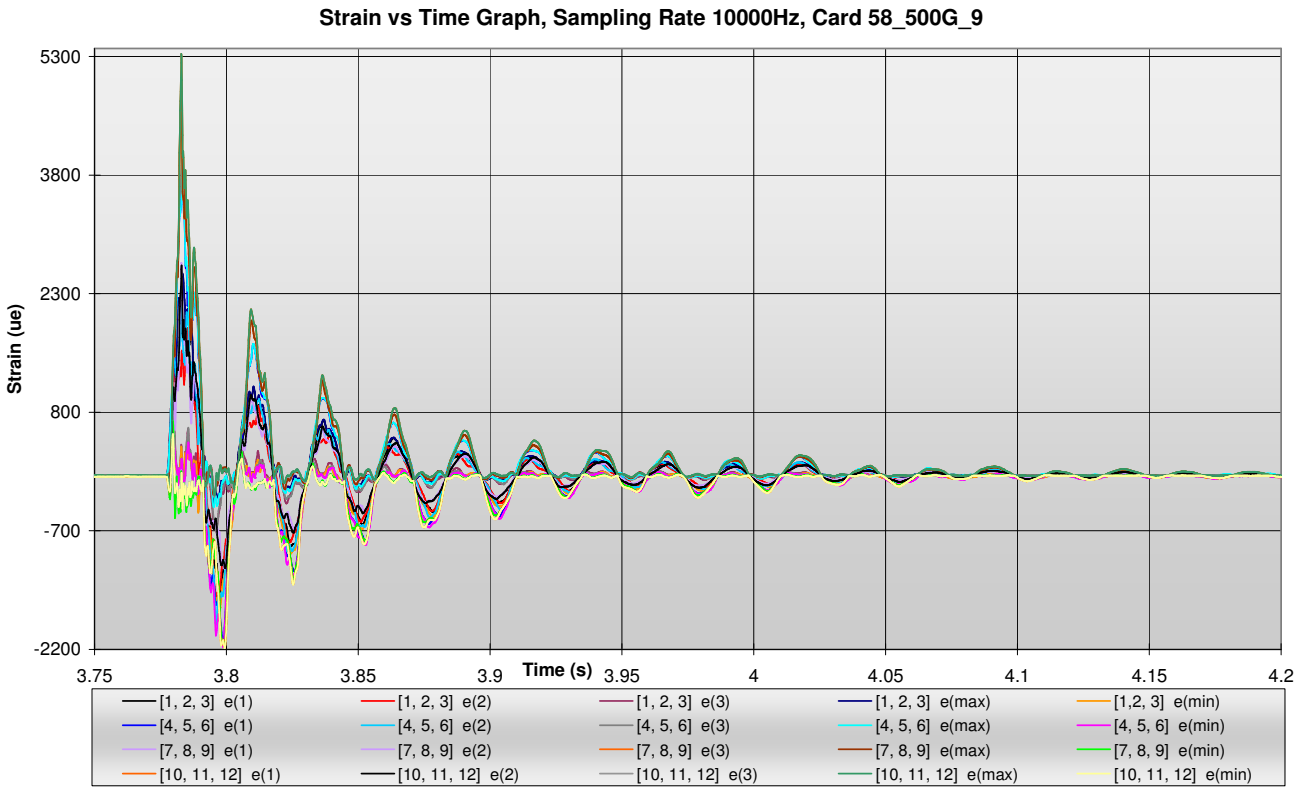
Card 58 – Drop 7



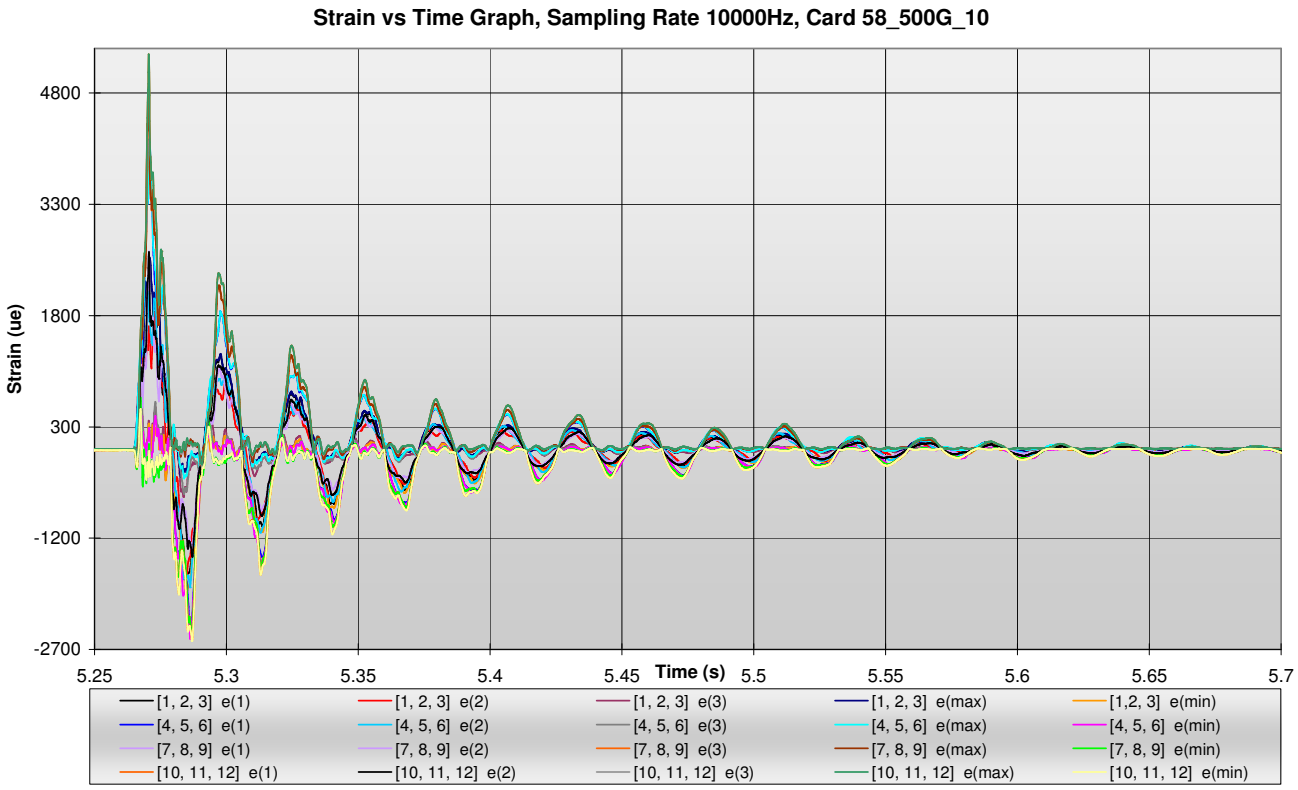
Card 58 – Drop 8



Card 58 – Drop 9



Card 58 – Drop 10



13. Event Detector Data

13.1 Set 1

Project Summary
NASA-1.xls

13.2 Set 2

Project Summary
NASA-2.xls

13.3 Set 3

Project Summary
NASA-3.xls

13.4 Set 4

Project Summary
NASA-4.xls

13.5 Set 5

Project Summary
NASA-5.xls

13.6 Set 6

Project Summary
NASA-6.xls

13.7 Set 7

Project Summary
NASA-7.xls